THURSDAY, AUGUST 26, 1915.

EVOLUTION: ORGANIC AND SOCIAL.

(1) *Evolution and the War.* By Dr. P. Chalmers Mitchell. Pp. xxv+114. (London: John Murray, 1915.) Price 2*s.* 6*d.* net.

(2) *Societal Evolution: a Study of the Evolutionary Basis of the Science of Society.* By Prof. A. G. Keller. Pp. xi+338. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 6*s.* 6*d.* net.

(3) *Symbiogenesis: The Universal Law of Progressive Evolution.* By H. Reinheimer. Pp. xxiii+425. (London: Knapp, Drewett and Sons, Ltd., 1915.) Price 10*s.* 6*d.* net.

(1) DR. CHALMERS MITCHELL'S vivid book begins with an interesting personal preface concerning his relations (as student and expert and *Saturday Reviewer*) with Germany. The first chapter deals with war and the struggle for existence, and contains a destructive criticism of von Bernhardi's "great verity" that "war is a fundamental law of evolution." The second chapter refutes some of the widespread misconceptions of the struggle for existence, and is a timely corrective. Taking the instances of dingo replacing thylacine, of the alleged war to the death between brown rat and black rat, and of the competition of cockroaches, the author shows that the cases are rarely stated with accuracy, and that they do not substantiate the conclusion that an incessant internecine warfare obtains throughout nature. We think that Dr. Chalmers Mitchell draws his bow too tightly when he declares (p. 23) that the competition Darwin chiefly thought of is internal, amongst the individuals of a species; and on the other hand, that he would have strengthened his position by extending it, by recognising that the technical phrase "the struggle for existence" includes all the reactions (non-competitive as well as competitive) that living creatures make to the pressure and stimulus of environing limitations and difficulties.

The third chapter is devoted to showing that even if the struggle for existence were the law of organic evolution (an unacceptable way of putting it), modern nations are not units of the same order as those of the animal and vegetable kingdom. A modern nation is not unified by blood-relationship; a political community coheres "because of bonds that are peculiar to the human race."

The fourth chapter expresses a wholesome scepticism as to the degree in which the stock of a nation can be altered by selective or eliminative agencies. Thus the author does not share the dread that some biologists have expressed of the dysgenic effects of the present war. But we do not yet—alas!—know the limit of the sifting. The fifth chapter defends the proposition that

"The most important of the moulding forces that produce the differences in nationality are epigenetic, that is to say that they are imposed on the hereditary material and have to be re-imposed in each generation." "The environment of the body and the environment of the mind determine national differences."

What is said in regard to the importance of the environmental factor carries conviction, but when the author expresses his belief that "nurture is inconceivably more important than nature," he is opposing complementary, not antithetic, factors, and committing the same error as that which he condemns in the pronouncements of those who have said that in the case of man hereditary nature has "an overwhelmingly greater significance" than nurture.

The book closes, all too soon for our taste, with a fine and often eloquent statement of the author's position in regard to the apartness of man from other living creatures. Organically we are mammals and "rooted deep in the natal mud" (an ungrateful phrase), but

"Our possession of consciousness and the sense of freedom is a vital and overmastering distinction. For man is not subject to the laws of the unconscious, and his conduct is to be judged not by them, but by its harmony with a real and external not-self that man has built up through the ages."

We think again that the author draws his bow too tightly, but it is of great interest to find this "hard-shell Darwinian evolutionist, a lover of the scalpel and microscope, and of patient empirical observation, who dislikes all forms of supernaturalism, who does not shrink" (Heaven forfend us from not shrinking from such nonsense) "from the implications of the phrase that thought is a secretion of the brain as bile is a secretion of the liver," asserting "as a biological fact that the moral law is as real and as external to man as the starry vault."

No one ever quite agrees with his brother's philosophy, but we think that all readers of this little book (and may there be many of them!) will agree in gratitude to the author. For what he has said is marked with sincere and resolute thinking, and is especially valuable at the present time.

(2) Prof. Keller is convinced that any fruitful study of the science of society must rest on a clear understanding of the Darwinian theory, and,

furthermore, "that the Darwinian factors of variation, selection, transmission, and adaptation are active in the life of societies as in that of organisms." His aim is to discover how far societary variation, selection, transmission and adaptation are the same as organismal variation, selection, transmission and adaptation. He recognises, indeed, that adaptations in mankind have come to be mainly mental and external (for we transform our environment as much as we are transformed by it), but he goes back to the simple and fundamental "folk-ways," which "form the germ and matrix of all human institutions," and inquires whether these are "adaptive by way of the activity of factors of the order of those operative in organic evolution."

The beginning of evolution is variation, and societary variations arise from individual initiatives unconscious or conscious. If these are effective and are diffused, obtaining group-approval, they become part of the body of folk-ways or of a thought-out social policy. As social phenomena they are subjected to societary selection, which the author proceeds to analyse. There are many forms of group-conflict and inter-group conflict, from internecine life and death struggle at the one extreme to the antagonism between class-codes at the other, but, on the whole, the automatic societal selection is on a different plane from natural selection. For one thing, there is "a lack of that precision, exactitude, and finality characteristic of a nature-process."

Elimination is much less thorough and survival is in virtue of social rather than biological superiorities. But emerging out of these automatic forms of societal selection there is deliberate rational selection, which works by rational criticism of the arts of societal self-maintenance. The practical difficulty arises, however, that forms of societal selection may run counter to natural selection by favouring the survival of those who are, when judged by biological standards, relatively less fit. Under the title of "counter-selection," this difficult problem is shrewdly discussed, the author's general position being that a certain amount of counter-selection is, at present at least, inevitable, and that it is to be met by more carefully thought-out rational selection. Thus the dysgenic results of war may be met or mitigated by more attention to practicable eugenics.

Turning to societary transmission—notably of the folkways which persist from generation to generation—the author points out that psychical qualities are transmitted in the biological sense, but much more is effected by tradition, both by positive inculcation and by unconscious imitation. The resultant of societary variation, selection, and transmission is adaptation, which the last quarter of the book illustrates. The author seeks to show that folkways and institutions are established as adaptations to particular settings in time and place. In the Eskimos, for instance, he finds "a primitive and isolated society, a survey of whose mores indicates beyond question the close adaptation of the maintenance-mores to environmental conditions, and the consistency of the other mores with those of self-maintenance." Another illustration worked out is that of two types of frontier-societies, the one in the temperate zone and the other in the tropics. Finally, the author uses "the modern great city as the best example at hand after which to outline the adaptation of the mores to the artificialised environment."

The whole book is interesting and will be valuable to those who wish to clear up their ideas in regard to "societal evolution." There is at times a tendency to a discursive exposition of the obvious, and to what seems to us an unnecessary amount of quotation from the late Prof. Sumner (of whose work this essay is regarded by the author as an extension); the reader may also be troubled a little by the reiteration of the words "folkways" and "mores," and by the occurrence of others even less familiar, such as "acculturation," "ethnocentrism," and "aleatory," but these are trifles compared with the fact that Prof. Keller has made a stimulating contribution towards answering the question: How does evolution in societary forms agree with, and differ from, evolution among organisms, both in itself and in the factors that bring it about?

(3) Mr. Reinheimer's book is marked by seriousness of purpose, width of inquiry, and a grasp of several important truths; it is marred by a lack of scientific precision and restraint, and by a litter of quotations of diverse values which have not always been understood. The author discourses at length on many subjects, such as genetics, of which he betrays inadequate understanding, and we think that he writes a lot of nonsense about the "symbiogenetic" potency of "love-foods"—which are the by-products of plant-reproduction, such as dates, raisins, bananas, legumes and cereals, with milk and eggs thrown in.

"To eat pork, hare, and shellfish is certainly not in accordance with the grand symbiotic division of labour which has established itself as the normal rule of life, demanding cross-feeding in the best interests of this symbiosis. Such habits are, on the contrary, opposed to the normal order, and result in an inferior physiological currency establishing itself at the expense of a nobler cur-

rency. This cannot lead to symbiogenesis, but must lead to pathogenesis."

The author is on firmer ground when he illustrates the widespread occurrence of interrelations linking organisms to organisms in mutual dependence and influence. Symbiogenesis is defined (by no means clearly) as "the mutual production and symbiotic utilisation of biological values by the united and correlated efforts of organisms of all descriptions," and the author's thesis is that this principle underlies "all creative life, all progressive evolution."

It seems to us a defensible proposition that there has been throughout organic evolution a complexifying of interrelations in the web of life. For a recognition of this truth we have to thank Darwin more than anyone else; therefore while we agree with Mr. Reinheimer that the struggle for existence includes much more than internecine competition, we deprecate the clumsiness (or worse) of a sentence like this (p. 399):

"We may likewise excuse Darwin for making a sweeping metaphor do (substitute) service pending the lack of systematic study and knowledge concerning the fundamentally important co-operative (symbiotic) factors which, indeed, he had not entirely overlooked, though insufficiently appreciated."

On page 401 we notice that the name of a naturalist "of world-fame" is three times misprinted.

BOOKS ON COTTON PRODUCTION.

(1) *The World's Cotton Crops.* By Prof. J. A. Todd. Pp. xiii+460. (London: A. and C. Black, Ltd., 1915.) Price 10*s.* net.

(2) *The Development and Properties of Raw Cotton.* By W. Lawrence Balls. Pp. xii+221. (London: A. and C. Black, Ltd., 1915.) Price 5*s.* net.

WITHIN the past few years numerous books and technical reports have appeared on the subject of cotton. The latest contributions are the two volumes before us, and both authors obtained their practical inspiration direct from the cotton fields of Egypt.

(1) Prof. Todd furnishes a review of the past history and present-day world's supply, on the basis of the trade statistics of all cotton-producing countries. It should prove invaluable alike to merchant and planter. It is fully illustrated with views of the cotton fields, the methods of transport, as well as numerous local incidents of interest in planting life. It moreover furnishes a series of ten maps to show the countries of production, the cotton areas of each being indicated by patches of vivid green. We would venture the suggestion that in addition to denoting the localities of recent expansion it would have been of advantage had some system of shading been pursued to indicate relative importance. For example, the first map, which shows the Indian localities, gives the valley of Assam coloured as fully and deeply as are Berar or Gujarat; all three might therefore be assumed to be equally important. So, again, while Prof. Todd gives the cotton areas of the United States of America as (approximately) 35½, India 24½, and Egypt 7½ million acres, the immense size of the green patch in the States conveys the impression of its being relatively larger than it is. It would have been a good plan, moreover, to have given numbers to the maps and to have shown these on the outside. In a like way we admit that trade names had to be given in a work of this nature, such as "Oomra-Wattee" (the modern Amraoti), but it would have facilitated reference had the orthography of the maps (Amraouati), at least, also appeared in the text.

An appendix affords what would seem to be full statistics (not always, we presume, easy to procure), and here brought into convenient form. A complete index has been given—a very necessary feature of a work of reference. The volume may be commended to persons in want of a book that deals briefly with every aspect of the commerce and agriculture of the world's cotton crop.

(2) Mr. Lawrence Balls's work furnishes the conclusions arrived at during an endeavour to improve the Egyptian cotton staple. If we differ from him in certain particulars we fully recognise the value of his labours. As a student of biology Mr. Balls has rendered a useful service, his contributions to the cytology and physiology of the cotton plant being welcome and of considerable importance. But in another branch of his studies he seems to have laboured under a delusion. It was unfortunate that the great urgency for research into the growth of the plant justified, in his mind, the setting on one side the results and evidences of systematic botany. He thus may be spoken of as having attempted to organise research on the exclusive basis of old pedigree selection and peripatetic Mendelian cross-breeding of undetermined stocks. In other words, he assumes that every investigator must deal with existing stocks and procure from these pure strains, but make little or no effort to derive new strains from internal or external sources.

As illustrative of Mr. Balls's disregard for the opinions of systematists it may be pointed out that he characterises scientific names as "merely useless duplicates of easier names." "Hindu-

weed" is to Mr. Balls a name sufficiently explicit for all practical purposes. He, moreover, manifests a reckless use of terms that often proves most ambiguous if not misleading. The cotton plant belongs, so we are told, to "the sub-order Gossypiæ (or Hibiscæ)"—there is no such sub-order. Our author next admits that some conception of the genealogical tree of the cotton plant becomes necessary, and hence he affords us a description of what he regards as its original ancestor. He then proceeds to say: "At the present day certain wild cottons are found which represent the descendants of this primitive ancestor not so much altered, such as the wild species *Gossypium sturtii* in Australia." "Not so much altered," and yet the wild species mentioned manifests a direct negation of practically every one of the characteristics of Mr. Balls's presumed primitive ancestor of cotton! It is thus hopeless to attempt to follow him into speculations of "cleavages" that gave rise to his "Asiatic," "Peruvian," and "Uplands" groups. "The grouping," he says, "of all species of cottons of the Peruvian type, for example, into groups of relations, each group being designated a sub-species." By another enigma a sub-species becomes a hybrid.

"The Indian group," we are told, "does not appear to cross with the Upland or Peruvian groups." That statement is given more than once, and its value obviously turns on the plants accepted as Indian, Upland, and Peruvian. It is, however, a fact that a cross has been obtained repeatedly, both in India and America, between an Indian and an American plant.

Why did not Mr. Balls furnish his readers with a botanical drawing of each of the chief plants investigated by him, or at all events with drawings of his three great divisions of which he has so much to say? His plates iii. and iv. are useless for that purpose.

We have felt it incumbent to exhibit the weak side of Mr. Balls's work, but we turn with pleasure to other portions of his book. The chapter on the Egyptian plant (as recognised by the author) is admirable. It sets forth in a vivid manner the different conditions of soil, water, and temperature that prevail in that country. He thus exemplifies the conditions that it would seem must exist before Egyptian stock can be successfully acclimatised in other countries.

The chapter on "Development of the Boll," though full of interesting details, is less practical than it may be presumed the author anticipated it might prove. Mr. Balls's method of investigating (and estimating) the productiveness of the plant, of testing the strength, as also of measuring the length of the fibre, are certainly clever and seem practical. But his chapter on the "Commercial Lint" confirms the necessity for critical study of all the races of the plant. The appendix affords a very much-needed key to Mr. Balls's methods of research, and is distinctly useful.

PLANT-LIFE IN SOUTH AFRICA AND CALIFORNIA.

(1) *Plants and their Ways in South Africa.* By Prof. B. Stoneman. New edition. Pp. xii + 387. (London: Longmans, Green and Co., 1915.) Price 5*s*.

(2) *The Ferns of South Africa, containing Descriptions and Figures of the Ferns and Fern Allies of South Africa.* By T. R. Sim. Second edition. Pp. ix + 384. Plates. (Cambridge: At the University Press, 1915.) Price 25*s*. net.

(3) *With the Flowers and Trees in California.* By C. F. Saunders. Pp. xii + 286. (London: Grant Richards, Ltd., 1914.) Price 7*s*. 6*d*. net.

(1) THE author of "Plants and their Ways in South Africa" has produced a useful text-book for the South African student of botany, a companion, that is to say, to class and practical work under supervision. A study of the seed and its germination leads on to the consideration of the growth of roots, stems and leaves, and of the duration of life of the plant. The form and structure of the parts, with a brief section on cells and tissues, is followed by a series of chapters on function. The chapter on the leaf is rather mechanical, and its subject-matter might with advantage have been more intimately associated with the portions dealing with plant-physiology. The study of the flower and fruit is associated with pollination and seed-distribution; and there is a short chapter on the remarkable Kukumakranka, a small bulbous plant belonging to the Amaryllidaceæ. The remainder of the book, comprising about one-half of the whole, is devoted to a sketch of the classification of plants, mainly the seed-bearing plants, with concise descriptions of those families and their representative genera which occur in South Africa. A short concluding chapter deals with the botanical regions of South Africa. The book is profusely and well illustrated with blocks, both original and borrowed from various sources.

(2) The first edition of Mr. Sim's "Ferns of South Africa" appeared in 1892, and was reviewed in NATURE of January 26, 1893. In the twenty-three years which have elapsed since, the exploration of the country north of the Orange, Vaal, and Umvolosi rivers and the opening up of Southern Rhodesia have added greatly to our

knowledge of the fern flora of the reconstituted South Africa. Hence the new edition of the book enumerates 220 species, as compared with 179 in the first edition, and, the author states, this number should be further increased when the northern Drakensberg ranges, the Portuguese mountain slopes, and the valleys of the Zambesi, have been more closely investigated. Mr. Sim has taken the opportunity of revising the nomenclature, which now follows Christensen's *Index Filicum*, and thus renders the volume comparable with recent fern literature. The arrangement adopted by Christensen is also followed in the classification of the ferns proper, that is, exclusive of the Lycopods, Psilotum, and Equisetum.

Of the introductory chapters, that on "Cultivation" has been rewritten and much extended; but there is room for a good chapter on the general life-history of a fern, which is at present somewhat scrappily treated. The plates are more numerous, 186 as against 159, and on the whole better, than in the first edition, and the general get-up of the book, which is now issued by the Cambridge Press, is also greatly improved.

(3) "With the Flowers and Trees in California" is a delightful series of word-pictures descriptive of the plant-life of one of the most brilliantly floriferous regions on the face of our earth. In a series of thirteen chapters, Mr. Saunders describes as many phases of his subject from first-hand knowledge. There is no definite plan, each chapter is complete in itself, and, open it where he will, the botanist or intelligent general reader will find matter of interest charmingly portrayed. The first chapter is retrospective: an attempt to depict the virgin flora as it appeared to the first white men who visited the country, the Portuguese navigators, and later the Padres, who were the earliest settlers. Some account is also given of early botanical explorations, especially of David Douglas, who introduced to European gardens so many Californian flowers and trees; the Yorkshireman, Thomas Nuttall; and the American, John Fremont. The author does not overstate the case when he says that "the value of annuals in horticultural effect was first realised when the Royal Horticultural Society of London sowed the seeds of the scores of beautiful annuals which their collector, David Douglas, back in the 1830's, brought them from California," and "the gardens of Europe are full of California wild flowers, such as clarkias, lupines, gilias, eschscholtzias, godetias, penstemons," and, best known of all, nemophila. Intimately associated with Douglas also are some of the finest conifers, which he discovered in the West American forests, *Pinus lambertiana*, the Douglas pine (*Pseudotsuga douglasii*), and many others.

The story of Californian plant life would not be complete without mention of the Big trees, and the chapter entitled "The Sequoia and its Adventures in Search of a Name" gives a racy account of the red-wood and its ally, the *Sequoia gigantea*, and the vicissitudes connected with the botanical name of the latter. If California has been generous she has also proved hospitable, and her wayside trees have been brought from all quarters of the globe; one may mention among many various palms, New Zealand cordylines, Australian eucalyptus, acacias, and casuarinas, and the widely-spread pepper-tree (*Schinus molle*), a native of Peru: as "the professor" remarks, "a walk along a California avenue is like a trip round the world." "Tree-hunting on a California desert" depicts another phase, and introduces the reader to the yuccas, mesquit, cacti, and brilliant-flowered shrubs of the desert. A few daintily coloured plates and a number of half-tone illustrations enhance the value of an interesting and eminently readable book.

THE FLY PEST.

(1) *Fighting the Fly Peril.* A Popular and Practical Handbook. By C. F. Plowman and W. F. Dearden. Pp. 127. (London: T. Fisher Unwin, Ltd., 1915.) Price 1*s.* net.

(2) *The House Fly: A Slayer of Men.* By F. W. FitzSimons. Pp. vi+89. (London: Longmans, Green and Co., 1915.) Price 1*s.* net.

(1) THIS volume is practically an exposition in popular terms of the use of borax as a destroyer of the eggs and larvæ of the house fly, with suitable quotations from Gordon Hewitt and other writers. The use of traps, of formalin, of some general precautions is also advocated. The authors lay stress on the importance of covering manure with soil, but it is not clear how far this will affect its rotting and so its manurial value.

Above all, the authors recommend borax, using the matter in Bulletin 118 of the United States Department of Agriculture and adducing an experiment of their own. We pass over the American bulletin, since it is now recognised in America that borax is not a suitable material for preventing fly-breeding in manure heaps. The "British Experiment" of chapter ix. is of interest, as it goes completely contrary to experiments made in this country on a much larger scale. This experiment was made in three tea boxes, with three cubic feet of manure in each. Flies hatched out from the untreated manure, not from the treated. It is noticeable that flies began to emerge on the eighth day from the untreated manure: they must

therefore have been there as larvæ from the beginning. The claim that the borax killed eggs is then untenable.

There is no information as to the number of maggots in the manure to start with, the temperature of the manure (a very important point), or the comparative temperatures of each lot. Practically, the book depends on one experiment, carried out under doubtful conditions and contrary to much larger experiments made here. We regret it, as it will mislead many, and lead to much useless employment of borax.

(2) The second volume is an attempt to get people to realise that the house fly is a real danger and to persuade them to cope with it. "Knowledge is power only when it is turned to practical use" is the opening to chapter vii., and we could quote other sentences full of meaning that occur in it.

The remedies advocated in it are usually sound and practical. Like others, the author fails to realise that the fly maggots live in material that is actually fermenting and in manure heaps that are hot, and that in consequence a purely superficial treatment will often kill them. It is also not true to say that "an insecticide to kill maggots must be about four or five times as strong as that used against other kinds of insects": it must be different, that is all.

The various chemical treatments recommended (salt, sodium arsenate, Paris green, sulphate of iron, etc.) are not practical for manure, nor are they cheap, and it would be interesting to know exactly what evidence there is of their effectiveness. Apart from this, the reader will find the book sound and helpful. It is written for South Africa, and all the methods advocated would not suit this country.

A chapter is devoted to the stable fly, which is possibly a disseminator of infantile paralysis. This chapter has special value now in England, as the stable fly is sometimes the only fly common in seaside resorts where children swarm, and most people, quite naturally, do not differentiate it from the house fly. When these matters are more fully investigated the importance of the stable fly will be settled. Meanwhile it is worth remembering that when people think that the house flies are biting them, in autumn, it is really the stable fly.

Of the two volumes we prefer the second, and we know of no other volume that is quite so simple, sensible, and practical. To those who wish to realise what the fly is, or does, without unnecessary scientific details, we commend this little book.

H. M. L.

OUR BOOKSHELF.

A Descriptive Monograph of Japanese Asteroidea, Part I. (Journal of the College of Science, Imperial University of Tokyo. Vol. xxix., Art. i. December 17th.) Pp. 808+xix plates. (Tokyo: The University, 1914.)

IN this large volume of about 800 pages only the Phanerozonia of Japan are included. Fifty-nine species are described, of which eighteen are new. The descriptions, in the case of thirty-nine species, are based on an examination of a number of collections preserved in various Japanese Institutions; but in the case of twenty species, which are not represented in any of the indigenous collections, either the extant description of the original author is quoted, or the species is very honestly expounded in a series of extracts from the several authors, who at different times have discussed and criticised it, in such a way that its definement suffers no perdition. The autoptical descriptions are excellent: they are clear and discriminative, and though rather tending to be meticulous, are far from being tedious or discursive. But in dealing with the history and literature of the subject the author is inclined not only to a redundance of quotation which is largely iterative, but also to burdening the quotations with a superfluity of their unimportant detail. Seeing that there is provided an exhaustive bibliography, filling over 100 pages, and concerned exclusively with papers cited in the text, this multiplication of undigested extracts descriptive of one and the same species is wearisome and unnecessary, though, of course, there are some who would not regard this feature as in any way a defect. On the whole, however, it must be allowed that this monograph is a wonderful piece of solid, honest work, the very card and calendar of taxonomy, and fit to stand among zoological works of reference of the very highest class. The typography is excellent, and there are nineteen double plates of admirable illustrations in photogravure.

In the copy under review pp. 81 to 86, which would appear to relate to *Ctenodiscus crispatus*, are wanting, and in their place pp. 97 to 112 are duplicated.

The Health of the Child: A Manual for Mothers and Nurses. By Dr. O. Hildesheim. Pp. xii +111. (London: Methuen and Co., Ltd., 1915.) Price 1s. net.

THE introduction to this work is written by Dr. G. F. Stell, the well-known Professor of Diseases of Children at King's College Hospital, and when he praises it, it is a work of supererogation of a mere reviewer to say ditto. The feeding, clothing, washing, nursing, and early education of the infant are all treated with admirable clearness and sound common-sense. The underlying doctrine that cleanliness and godliness are akin, if not identical, is forcibly pressed home. The book may not only be placed safely in the hands of every mother and nurse, but it seems almost unsafe to allow any mother and nurse to be without this excellent shillingsworth. W. D. H.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Analogy between Radicles and Elements.

THE remarkable chemical analogy of the ammonium radicle and the alkali metals may be explained with the help of Bohr's theory of atomic structure. According to Bohr, the atom of nitrogen consists of a nucleus with a positive charge of $7e$, surrounded by two rings of electrons, the inner containing 4, the outer 3 electrons. N is, therefore, represented by 7 (4, 3). Ordinary chemical compounds are supposed to be held together by rings of electrons rotating in planes perpendicular to the lines connecting the nuclei of the composing atoms; so that NH_3 may be represented by (4, 3−3). This principle leads, however, to difficulties, if applied to NH_4; a configuration (4, 3−4) seems impossible. It is better to suppose the nuclei and electrons to rearrange themselves within the atom. I assume, therefore, that the nuclei unite, or at least that they get quite close to each other, in the centre of the system, while the electrons arrange themselves in four rings (4, 4, 2, 1), rotating round the joined nuclei. It may seem difficult to bring the nuclei together against the repelling forces, but it must be remembered that the radicle NH_4 can only be formed by indirect methods; in no circumstances will ammonia and hydrogen unite to form NH_4. The co-operation of another molecule containing hydrogen, like H_2O, HCl, is absolutely necessary, an intermediate compound first being formed, from which the ammonium-ion is produced by electrolytic dissociation. Once liberated, the ammonium decomposes immediately; it is extremely unstable, exactly conforming to our expectations. It is also important to remark in this connection, that, according to Coehn, electric charges are given off during the decomposition.

The arrangement proposed at once shows analogies with Bohr's representation of Na (8, 2, 1) and K (8, 8, 2, 1). These two configurations contain the same outer rings as NH_4 and differ only with regard to the inner rings. The number of electrons in Na and NH_4 is even the same; in K and NH_4 we find the same number of rings. The second similarity seems to be of primary importance, ammonium resembling potassium more closely than sodium. The fact that the analogy does not go further than the chemical properties follows at once from the general principle that the chemical character of a substance depends only on the outer rings.

The same considerations apply, of course, to PH_4, which, however, is only known as an ion, and AsH_4, and perhaps to hydrazine, which shows some resemblance to calcium. Whether the substituted ammonium bases may also be drawn within their scope is not yet settled.

There is still another line of thought to which I wish to direct attention. In the periodic table nitrogen is placed in the fifth group. When it combines with four hydrogen atoms, according to the above hypothesis, the nucleus charge increases by $4e$; the resulting radicle is analogous to a metal of the first group, *i.e.* to an element which occupies the *fourth* place on the right of the original element. This is exactly the reverse of the radio-active transformations in which by the loss of an α particle ($2e$) the atom removes two places to the left.

This idea may also be applied to the analogous sulphur and iodine bases. Although these are only known in compounds, in which the hydrogen atoms are substituted by aliphatic or aromatic radicles, we shall take for discussion the fundamental types; instead of SR_3OH and IR_2OH, we consider the radicles SH_3 and IH_2. SH_3 also has the chemical properties of an alkali metal. Now, sulphur is placed in the sixth group; if the nucleus takes up three elementary charges, $3e$, the atom shifts its position by *three* places to the right, and arrives in the first group, thus confirming the general law. Also, the change of the iodine atom (seventh group) by taking up two hydrogen atoms, $2e$, is an agreement with the theory, for the iodonium radicle also exhibits the properties of a strong base. Iodonium, it is true, especially resembles thallium, but it is known that thallium and silver are closely similar; so iodonium also fits in the first group.

The above considerations may be extended to cyanogen and the halogens, which also show a striking resemblance. Though cyanogen is not unstable, it is not easily obtained. Its formation is only possible at high temperatures, and in the presence of alkalis, or by the use of electric discharges. It is a strongly endothermic compound. The structure of the CN radicle may be represented by 13 (4, 4, 4, 1), whilst Bohr writes fluorine 9 (4, 4, 1), and chlorine 17 (8, 4, 4, 1).

E. H. BUCHNER.

Chemical Laboratory, University of Amsterdam,
July, 1915.

The Density of Molecules in Interstellar Space.

IN recent years evidence has been brought forward by several investigators[1] indicating that light from distant stars suffers a slight attenuation in travelling through interstellar space. In particular a recent investigation by Jones[2] assigns fairly definite numerical values to coefficients of attenuation corresponding to "photographic" and "visual" light from stars of known proper motions and spectral types the magnitudes of which had been carefully measured by Parkhurst[3] for light of these wave-lengths. If, as seems reasonable, this extinction is assumed to be due to attenuation by scattering in travelling through a "residual" gas occupying interstellar space, we are enabled to estimate the average density of molecules in the intervening regions, following a method due originally to Larmor[4] for assigning an upper limit to the density of matter in comets' tails.

If we denote by κ the coefficient of attenuation corresponding to wave-length λ, radiation of this wave-length originally of intensity E_0 is reduced, after travelling a distance x, to the value given by $E = E_0 e^{-\kappa x}$. According to Rayleigh's law of molecular scattering, κ is given in terms of the refractive index μ, and the molecular density of the medium n by the relation $\kappa = \frac{8}{3}\pi^3(\mu^2-1)^2\lambda^{-4}/n$. The ability of Rayleigh's law to account almost completely for the attenuation of solar radiation in travelling through the earth's atmosphere was first pointed out by Schuster[5]; a later investigation by the writer,[6] based on the results of the Smithsonian Astrophysical Observatory, indicated that formulæ based on this law were competent to explain atmospheric extinction as well as to account quantitatively and qualitatively

1 Kapteyn, J. C., *Astrophysical Journal*, xxix. (1909), pp. 46–54; xxx. (1909), pp. 284–317 and correction p. 308. Turner, H. H., *Monthly Notices* Roy. Ast. Soc., lxix. (1908), p. 61. King, E. S., *Harvard Annals*, lix., No. 6, p. 179, April, 1911; *Harvard Annals*, lxxvi., No. 1, pp. 1–10. 1913. Brown, F. G., *Monthly Notices*, lxxii. (1912), p. 195, also p. 718.

2 Jones, H. S., *Monthly Notices* Roy. Ast. Soc., lxxv (1914), pp. 4–16.

3 Parkhurst, J. A., "Yerkes Actinometry," *Astrophysical Journal*, xxxvi. (1912), p. 160.

4 Larmor, Sir J., Lectures, Cambridge, 1908.

5 Schuster, A., NATURE, July 22, 1909; "Optics," 2nd Edition, 1909, p. 320.

6 King, L. V., Phil. Trans. Roy. Soc., ccxii. A (1912), pp. 375–433.

for the intensity and distribution of sky-radiation as far as the observations available at that time could be tested. As a final test, the Smithsonian results were reduced with a view to obtaining a value for the number of molecules per cm.^{3} of a gas at standard temperature and pressure; the result obtained by the writer,[7] $n_0=(2{\cdot}78\pm0{\cdot}01)\times10^{19}$, and a later independent determination by Fowle,[8] $n_0=(2{\cdot}70\pm0{\cdot}02)\times10^{19}$, indicate that we may rely with confidence on Rayleigh's law in dealing with molecular extinction for wave-lengths not too close to regions of selective absorption.

In dealing with attenuation in a stellar distance $x=\Delta$, the term $\kappa\Delta$ is so small that we may write to sufficient degree of approximation $\kappa\Delta=(E_0-E)/E_0$, *i.e.* $\kappa\Delta$ is the proportional loss of intensity in travelling a distance Δ. Denoting by $\kappa_1\Delta$ and $\kappa_2\Delta$ the proportional losses of intensities corresponding to "photographic" and "visual" light of average wave-lengths λ_1 and λ_2 respectively, we derive on reducing to intensities the result obtained by Jones,[9] [(photographic)−(visual)] losses $=+0{\cdot}00473\pm0{\cdot}00035$ magnitude, the relation $(\kappa_1-\kappa_2)\Delta=0{\cdot}00435\pm0{\cdot}00032$, the distance Δ being 10 parsecs (1 parsec = distance corresponding to a stellar parallax of $1''=3{\cdot}26$ light-years $=3{\cdot}08\times10^{19}$ cm.). If it is assumed that the extinction is brought about solely by molecular scattering, we also have the additional equation $\kappa_1/\kappa_2=(\lambda_2/\lambda_1)^4$.

Unfortunately, it is somewhat difficult to assign with accuracy the average wave-lengths corresponding to "photographic" and "visual" light. A rough estimate by the writer from Parkhurst's curves of spectral intensities corresponding to the plates and filters employed in the photographic and visual determinations yielded the values $\lambda_1=0{\cdot}446\mu$ and $\lambda_2=0{\cdot}533\mu$, so that we obtain $\kappa_1/\kappa_2=2{\cdot}08$, giving $\kappa_1\Delta=0{\cdot}0083_3$ and $\kappa_2\Delta=0{\cdot}0040_3$.[10] In order to realise more vividly the extremely small attenuation which these numbers represent, it is easily verified that in order to lose one-tenth of its original intensity radiation of these wave-lengths must travel for about 4·1 and 8·5 centuries respectively.

For the purposes of the present discussion we assume hydrogen to be the constituent of interstellar space (until we know more about the physical properties of "coronium," "nebulium," or other primordial gases which might possibly occupy these regions). Taking $\mu_0-1=0{\cdot}000140$, $n_0=2{\cdot}78\times10^{19}$, $\lambda=4{\cdot}46\times10^{-5}$ cm., we easily derive for the coefficient of attenuation in hydrogen at standard temperature and pressure the value $\kappa_0=5{\cdot}89\times10^{-4}$ cm.$^{-1}$. For this wave-length in interstellar space we have $\kappa=2{\cdot}72\times10^{-22}$ cm.$^{-1}$, so that $n/n_0=\kappa/\kappa_0=4{\cdot}62\times10^{-18}$, giving finally for the molecular density in interstellar space the estimate $n=1{\cdot}28\times10^{5}$ hydrogen molecules per cm^3.[10]

Associated with the problem of attenuation by scattering is that of calculating the amount of starlight scattered by the molecules of interstellar gas.[11] In this way might be explained the extremely faint luminosity which several observers believe to exist over the background of the sky. This scattered light might also account for discrepancies which have been found to exist between calculated and observed distributions of total starlight from different regions of the night sky.[12] The estimation of the amount of solar radiation scattered to the earth by a distribution of interstellar gas constitutes a definite problem, the complete statement of which (including the effect of self-illumination) is expressed as a particular case by a general integral equation already given by the writer.[13] The theoretical discussion applicable to the problem under discussion the writer hopes to undertake elsewhere; from the observational point of view it would seem that the difficult, but perhaps not impossible, task of estimating the luminosity of the sky in regions void of stars affords the only hope of bringing additional direct evidence to bear on some of the questions raised below.

In a gas of the extreme degree of tenuity which we have just estimated, molecular collisions will be extremely infrequent; an estimate of the free path, according to the usual ideas of the kinetic theory, is impossible without a knowledge of the average molecular velocity or temperature of the gas. As has already been pointed out by the writer,[14] it is difficult to see how molecular velocities can be directly affected by radiation travelling through a gaseous medium. It is probable that gravitation and radiation-pressure are the controlling forces in determining molecular velocities by an extremely slow process of equipartition of energy with that of molecules escaping from planetary and stellar atmospheres.

As the above estimate of molecular density gives a total amount of matter of the order $1/38\times$ earth's mass in a sphere having a radius equal to that of Neptune's orbit, it is improbable that the residual gas we are considering could have a noticeable effect on planetary motions. It might, however, be identified with the slightly resisting medium the existence of which has been thought necessary by some astronomers to account for the secular acceleration of Encke's comet,[15] and which is considered by See[16] to have played an important *rôle* in planetary and stellar evolution.

The molecular density estimated above is very much less than that conjectured to exist in some of the nebulæ, 10^9 molecules per cm.^{3} being about the order of magnitude in this case.[17] While the degree of rarefaction which we have derived is very much greater than it is possible to produce by any known physical means,[18] the total amount of matter contained in regions of space of astronomical dimensions is formidable; thus we find for the number of molecules in a cubic parsec the estimate $N=3{\cdot}75\times10^{60}$ hydrogen molecules per parsec^3. Taking the density of hydrogen at standard temperature and pressure to be 0·0899 gramme per litre (containing $2{\cdot}78\times10^{22}$ molecules), we obtain for the density of matter in interstellar space the estimate $1{\cdot}21\times10^{37}$ grammes per parsec^3; as the sun's mass is approximately $1{\cdot}96\times10^{33}$ grammes, we have finally for the density of interstellar residual gas the estimate $6{\cdot}3\times10^{3}$ sun's mass per parsec^3. According to Eddington,[19] a reasonable

7 King, L. V., NATURE, xciii. (July 30, 1914), pp. 557–559.

8 Fowle, F. E., *Astrophysical Journal*, xl. (December, 1914), pp. 435–442.

9 Jones' determination is in fair agreement with Kapteyn's final result, (*Astrophysical Journal*, xxx., p. 398):

[(photographic)—(visual)] losses $=+0^m{\cdot}0031\pm0^m{\cdot}0006$.

The corresponding determinations by King (E. S.) of the coefficients of attenuation for photographic and visual light give values about five times that of the text.

10 The losses $+0^m{\cdot}0080$ and $+0^m{\cdot}0033$ estimated by Jones for "photographic" and "visual" light lead to the values $K_1\Delta=0{\cdot}0073$ and $K_2\Delta=0{\cdot}0030$ (wave-lengths not stated). Kapteyn's (corrected) estimate for wave-length $\lambda_1=0{\cdot}431\mu$ is $K_1\Delta=0{\cdot}00507$, leading to the value $n=0{\cdot}68\times10^5$ hydrogen molecules per cm.^{3}, which is of the same order of magnitude as the determination already made. E. S. King's results (footnote 1) increase the estimate of the text about five-fold.

11 Note a discussion on this point by H. C. Plummer in a paper by H. H. Turner, *loc. cit.* (footnote 1).

12 Abbot, C. G., *Astronomical Journal*, xxvii. (1911), p. 90; "Annals of the Smithsonian Astrophysical Observatory," vol. iii. (1913), pp. 203–210.

13 King, L. V., footnote (6), p. 379, equation (14).

14 King, L. V., footnote (7).

15 On the recent history of this comet see a paper by Backlund, "Encke's Comet, 1805–1908," *Monthly Notices*, lxx. (1910), pp. 429–442.

16 See, T. J. J., "Researches on the Evolution of the Stellar System," 1910, vol. ii., pp. 134–158.

17 Henkel, F. W., in an article "Nébuleuses et Essaims," *Scientia*, vol. xv. (1914), pp. 294–307.

18 The total number of molecules per cm.^{3} corresponding to the vapour-pressure of mercury at the temperature of liquid air is estimated at 3×10^7 (Dunoyer, M. L., "Les Gaz ultra-raréfiés," in the collection "Les Idées Modernes sur la Constitution de la Matière," Paris, Gauthier-Villars, 1913, p. 216).

19 Eddington, A. S., "Stellar Movements and the Structure of the Universe." Macmillan and Co., Ltd., 1914, p. 255.

estimate of the density of visible stars in the neighbourhood of the solar system is 10 × sun's mass in a sphere of 5 parsecs radius (525 parsec^3), *i.e.* 0·019 × sun's mass per parsec^3. It follows that the density of "uncondensed" or "residual" matter existing in interstellar space is of the order 10^5 that of "condensed" stellar matter. Even if, as there is some reason to believe, the number of "dark" stars is very much greater than the number of bright ones (Lindemann's estimate is 4000),[20] the ratio referred to is still very large.

It is evident that unless this "residual" or "primordial" gas is exempt from mutual gravitation[21] it must give rise to a gravitational field very much greater than that of the whole sidereal universe, and should therefore be taken into account in existing theories of stellar dynamics. Although the dynamics of such a system would probably have to be modified to a considerable extent to take into account radiation pressure, we should still expect an enormously high density near its mass-centre, unless the whole be endowed with a small angular velocity, as is surmised to be the case with the Milky Way.

It follows from this brief discussion that we are either obliged to accept the existence of a widespread distribution of enormous quantities of interstellar gas of molecular density of the order 10^6 molecules per cm.^{3} and take into account its influence in stellar dynamics, or conclude that the attenuation of light by scattering is very much less than is indicated by existing estimates of the absorption of stellar radiation in space. LOUIS VESSOT KING.

McGill University, Montreal, June 30, 1915.

The Great Aurora of June 16, 1915.

IN reply to Dr. Chree's note in NATURE for July 22 concerning the auroral display of June 16, I would say that the times (as indicated in my note in NATURE for July 15) were in Greenwich Mean Time. This, of course, begins at Greenwich Mean Noon. It did not occur to me that this might be misleading to the unastronomical reader. If one will subtract twelve hours from the times given by me, he will then have the dates for the morning of June 17 at Greenwich. Thus June 16d. 15h. 30m. G.M.T. will be June 17d. 3h. 30m. a.m., Greenwich Civil Time.

I will take the opportunity to quote here from the Los Angeles (Cal.) *Tribune* of June 18, 1915, a despatch from Chicago dated June 17:—

"Chicago telegraph operators were puzzled to-day when their wires failed at times to work. Soon, however, the explanation of the trouble came. It was not due to power stations or lack of current, but to the aurora borealis.

"The bewildering beauty of the northern lights lighted up all of Canada and the north-western part of the United States last night and caused electrical disturbances that put telegraph wires entirely out of commission in Idaho, Montana, and the Dakotas and along the Canadian Pacific railroad.

"The disturbances extended to Chicago to-day and to-night, and reports of trouble between Pittsburgh and New York, St. Louis and Kansas City, and many other cities over the country, were received. Operators here stated to-night that the disturbance was the worst they had known in five years.

"W. F. Weber, wire chief for the Western Union, reported service considerably demoralised.

"'Our wires the whole length of the land were badly affected early to-day,' he said. 'They are affected still, though not to such a degree. The disturbance of the atmosphere causes fluctuation of the current on the wires, and interferes with rapid transmission of signals. We have been obliged to operate at a much lower speed than normal to-day.'

"The Postal Telegraph Company was similarly affected.

"It also was reported that train-dispatching on the Canadian Pacific railroad virtually ceased for several hours. Similar conditions prevailed on other northern transcontinental lines." E. E. BARNARD.

Yerkes Observatory, Williams Bay, Wisconsin, August 4.

[20] Lindemann, F. A., "Note on the Number of Dark Stars," *Monthly Notices*, lxxv. (1915).

[21] On this point note a remark by Eddington, *loc. cit.*, p. 258.

Use of Celluloid in Periscope Mirrors.

I SHOULD be glad to know, in reference to the possibilities of diminishing the danger in using periscopes under fire: (1) whether experiments have been tried as to the effect of cementing a plate of celluloid to the back of the exposed mirror in preventing or reducing the splintering of the glass when struck by a bullet, and, if so, with what result; (2) whether there is any danger involved in the use of celluloid for this purpose?

EDWARD M. LANGLEY.

48 Waterloo Road, Bedford, August 17.

Foreign Philosophers.

ONE of the original objects of our Association for the Advancement of Science was to encourage the exchange of ideas with foreign philosophers, *vide* First Report of B.A. This year it will be a disappointment to many people in Manchester to have so few distinguished strangers. We now call them prisoners of war or alien enemies. But they still wish for scientific enlightenment.

Inquiries made in the prisoners' camp at Stobs reveal a small library carefully catalogued. They have some hundreds of English books, including some scientific books; also, in German, Schiller and Goethe. They ask particularly for Naturwissenschaft in Deutsch, Chemie, Physik, Geologie, Botanik, also agriculture (Landwirthschaft), navigation, engineering, mathematics, mathematical astronomy for seamen, logarithms, Electrotechnik. There are repeated inquiries for a German book on spherical trigonometry, enough copies for the navigation class.

The requests we have the honour to transmit may be satisfied by sending books direct to Von Vorman, Librarian, Prisoner of War, Hut 18, Compound A, Stobs, near Hawick, Scotland. Inquiries as to books likely to be welcome in other camps may be addressed to the Emergency Committee, 169 St. Stephen's House, Westminster Bridge, S.W.

Some of the prisoners have already expressed a general willingness to remind their friends in Germany (with whom they are privileged to communicate) that the English prisoners in German camps are also asking for books.

Books sent by passenger train should be carriage paid, by parcels post they go free of charge.

August, 1915. HUGH RICHARDSON.

French Magnanimity.

FRENCH history furnishes an interesting parallel to the magnanimity shown by Napoleon to the University of Pavia referred to in your issue of July 15. When Rudyerd was engaged in building the second Eddystone Lighthouse a French privateer captured some of his workmen and carried them prisoners to France. Louis XIV., however, as soon as he heard of it, put the captain and crew in prison, released the workmen, loaded them with presents, and sent them home, saying that though he was at war with England, he was not at war with mankind.

GORDON D. KNOX.

11, Garrick Street, W.C., August 17.

ANTARCTIC FOSSIL PLANTS.[1]

PROF. SEWARD'S Memoir is the first of the British Museum Reports dealing with the natural history results of Capt. Scott's second Antarctic expedition. The work is finely illustrated, and provided with excellent maps. The specimens described are of unequalled interest among fossil plants, from their occurrence so near the Pole, and from the tragic circumstances of their discovery.

The report begins with a few notes on palæobotanical records from previous expeditions. Though of considerable interest as demonstrating the former existence of vegetation on the Antarctic Continent, these earlier records were of little botanical value, none of the specimens admitting definite determination. The really important Antarctic specimens of fossil plants are among the fruits of Capt. Scott's second expedition.

FIG. 1.—The medial moraine on the Priestley Glacier. From "Antarctic Fossil Plant-," by A. C. Seward, F.R.S.

The petrified remains of a tree, named by the author *Antarcticoxylon priestleyi*, were discovered by the northern party on February 1, 1912, on the moraine of the Priestley Glacier, south of latitude 74° S. Still more important discoveries were made by the Polar party at Mount Buckley in latitude 85° S., on February 8, 1912 (see our illustration). This was on their sad return journey and less than six weeks before the end. The "beautifully traced leaves in layers" found in "veritable coal-seams" in the Beacon Sandstone, are found to belong to the well-known species *Glossopteris indica*, which is thus shown to occur in abundance only about 300 miles from the South Pole. The fact that there is some evidence of drifting does not materially affect the interest of this astonishing discovery. The nature of the plant is beyond doubt, as shown by the excellent photographs, and the finding of so well-characterised a member of the Gondwana Flora was peculiarly fortunate. The stems and scale-leaves of Glossopteris also appear to be present.

The fossil wood, *Antarcticoxylon priestleyi*, from the Priestley Glacier, is described in full detail, with the aid of numerous microphotographs; an interesting point is the presence of well-marked annual rings. The occurrence of concentric bands of cellular tissue in the wood is a peculiar feature, possibly to be explained as a reaction to wounding during life. The wood shows affinity with that of Cordaites, but is regarded as the type of a new genus.

The author might perhaps have compared his specimens with *Mesopitys tchihatcheffi*, a Permian plant from the Altai, fully described by Zalessky in 1911; the two stems have a good deal in common, notably in the presence of annual rings, the single leaf-traces and the structure of the primary wood.

Other, less well preserved, specimens of Antarctic wood are all regarded as probably Gymnospermous.

A curious discovery is that of a body (*Pityosporites antarcticus*) apparently representing a winged pollen-grain; it was found in the matrix of a partially decayed stem of Antarcticoxylon. Winged pollen-grains occur both in the Firs and the Podocarpineæ; on geographical grounds the latter group appears the more probable, but the agreement with the pollen of the Abietineæ seems to be closer.

[1] "Antarctic Fossil Plants." By A. C. Seward, F.R.S. British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Geology, vol. i., No. 1, pp. 1-49+viii plates. (London, 1914.) Price 6*s*.

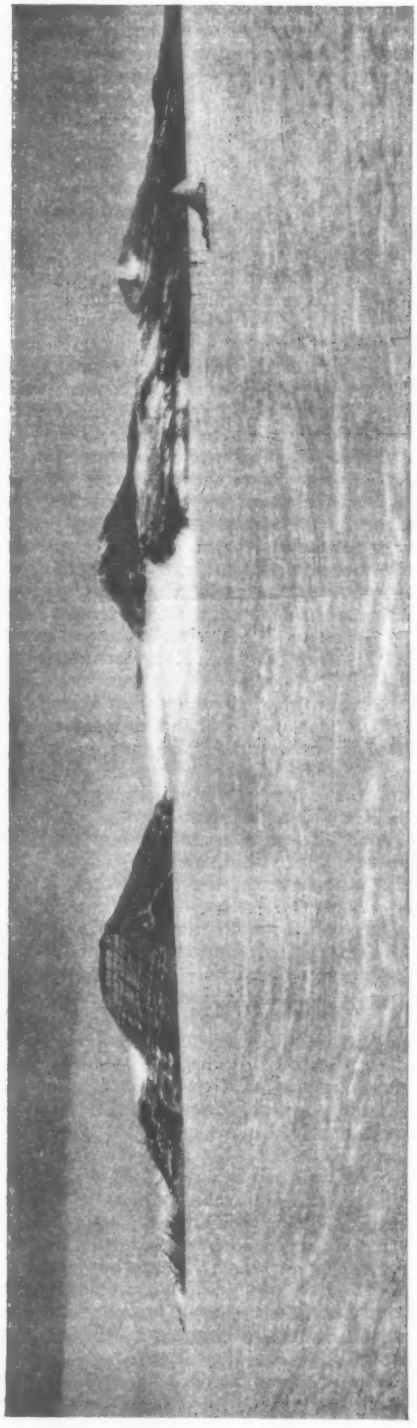

FIG. 2.—Buckley Island from the Beardmore Glacier. From "Antarctic Fossil Plants," by A. C. Seward, F.R.S.

As regards the age of the plant-bearing beds the possibilities range from the Permo-Carboniferous to the Rhaetic; the former is regarded as the more probable.

A considerable section of the paper is devoted to "General Considerations suggested by the occurrence of Glossopteris in Antarctica" (pp. 25–39). The uniformity of the Devono-Carboniferous flora throughout the world is contrasted with the appearance of more or less distinct Northern and Southern Floras in Permo-Carboniferous times. In the northern region there is no evidence of seasonal changes or of glacial conditions, while in the south glaciation was widely prevalent, and the fossil trees show annual rings in their wood. In fact, as the author points out, the Glossopteris Flora is generally associated with glacial deposits. The interesting suggestion is made that Glossopteris may have been a gregarious and deciduous plant.

The prevalence of glacial conditions in the southern hemisphere at that period adds to the difficulty of understanding how a highly organised vegetation could have flourished so near the Pole as Lat. 85°. No explanation, unfortunately, can be given; the author contents himself with the cautious statement: "That there has been a considerable change of climate is certain, but the palæobotanical data cannot be regarded as evidence favourable to an alteration in the position of the earth's axis." (p. 41).

Prof. Seward regards the Antarctic discoveries as supporting the late Dr. Blanford's view that the Glossopteris Flora may have been first differentiated on the great Antarctic continent, towards the close of the Carboniferous epoch (p. 42).

The concluding words of the memoir command our sympathy: "The heroic efforts of the Polar party were not in vain. They have laid a solid foundation; their success raises hope for the future, and will stimulate their successors to provide material for the superstructure."

D. H. S.

FUTURE COMPETITION WITH GERMANY.

THE current issue of the *Bulletin d'Encouragement pour l'Industrie nationale* (May–June, 1915, No. 3, vol. 122) is of special interest, inasmuch as it gives the views of men, each eminent in his own particular sphere, on the reasons why much of French trade has been captured by Germans; and also their suggestions for preventing the commercial aggression of the Germans after the war. The bulletin begins with a short preface by the president, M. Léon Lindet; this is followed by suggestions by M. Niclousse to the following effect: (i) A statute is to be passed for stopping foreign, and especially German, individuals, companies, or products from masquerading as French. It is urged that all machines, apparatus, and products should be of French manufacture and, if possible, invented by a Frenchman. (ii) A circular to be issued by the Syndicate

of Mechanicians, Boiler-makers, and Foundrymen, urging the public to avoid purchasing anything of German or Austro-Hungarian manufacture, and to buy rather from the Allies. (iii) To prevent Frenchmen from acting as agents for the enemy. (iv) To employ no German means of transport.

Much of the French material was made in districts now occupied by Germany; it is sad to read that 95 per cent. of the steel made by the Gilchrist-Thomas process, 90 per cent. of the iron ore, 100 per cent. of steel tubes, 76·6 per cent. of rails, etc., formerly made in France, are now in German hands. On the other hand, iron alloys, cast-iron, spiegel-iron, iron coated with zinc, copper, and lead, have been little affected.

It is also hoped that duties will no longer be levied on raw materials; French manufacture has hitherto been handicapped by this.

The Syndicate of Pharmacy also suggests that French medical men be circularised, and that lists be furnished them of substances of German origin which should not be purchased. The Society of Lithographers, in its report, states that lithographic stones, previously obtained from Munich, may be replaced by plates of zinc and aluminium with advantage. Bronze leaves, and bronze, copper, and aluminium powders, it appears, have not been made in France; it is recommended that their manufacture be begun. The German success has been largely due to long credits; they sell machines, and by their banking system can afford to wait long for payment. Subsidised German transport gives German manufacturers a great advantage; it is often cheaper for a Frenchman to send his goods through Hamburg than directly from one part of France to another. A better French consular system is called for, as well as the revival of apprenticeship, and the more loyal co-operation of workmen.

Portland cement has not been troubled with German competition in France; but the machines are of German make. It appears that 80 per cent. of the cement works are in territory at present occupied by the German army.

Agricultural implements, though made to some extent in France, have largely been imported from the United States. It is suggested in this report that lending corporations, trusting for repayment to the honour of the borrowers, would be of great service, and that they would rarely have loans out to defaulters.

Such are the reports on various industries. They all reprobate German methods as unfair, while giving credit to the Germans for great industry and power of organisation.

A long article follows by Prof. Henri Hauser, of Dijon, on "German Industry as a Factor in War." He attributes to the Germans the good qualities of regular, methodical work, and a sense of, or even a genius for, organisation. "It is the union of the laboratory and the factory which has created German wealth." "It is also to be remarked that there is a close link between the director's office and the library of the economist, the geographer, and the historian." "The German chemist and the German commercial traveller walk side by side to conquer the world." These and other similar aphorisms explain the astonishingly rapid growth of German industry.

Nothing is more erroneous than to describe Germany as an over-peopled country. Of the 67 million Germans, 17 millions are tillers of the soil; but every year peasants throng into the towns; there are above 45 towns of more than 100,000 inhabitants. Cereals and meat have to be imported to feed 20 million Germans. Cotton is the largest import; its value is about 500 million marks, or 25 million pounds sterling. Germany requires much capital; new companies and ventures are continually being started; and owing to the system of credit, it may be said that she swallows capital before its birth. Companies with an imposing capital rest on the credit of industrial banks; these on Central banks; these again on the Deutsche Bank, which is guaranteed by the Reichsbank, that is, the credit of the whole German State. In order to pay for her imports, foreign trade is essential to Germany; she must sell her manufactured products. *This war is being waged to keep and to gain foreign commerce.* Konrad Hönisch, the Social-Democrat, said: "It is the social interests of the proletariat, even more than any political considerations, which render the victory of Germany imperative." The Industrial State is therefore condemned to participate in a "Welt-politik."

Prof. Hauser gives instances of "dumping"; *e.g.*, in 1900, iron wire cost in Germany 25 marks per 100 kilograms, and elsewhere 14 marks; in 1902, the Coke Syndicate forced the consumer to pay 15 marks a ton, while coke was sold abroad for 11 marks. But the gain exceeds the loss; the State-supported syndicate makes this possible. In the former instance there was a loss on foreign trade of 859,000 marks, but a gain on home trade of 1,117,000 marks.

The Germans form companies abroad, largely from foreign capital; but the majority of the directorate are Germans. For example, the *Banque des Chemins de Fer orientaux* of Zürich has a board of eight German directors, one Austrian, five Swiss, one French, and one Belgian. The ordinary shares are all held by Germans; the preference shares, with a lower rate of interest, by the foreign subscribers, for the low rate of interest does not tempt German investors. In Italy a similar state of things exists. All large concerns, such as the Nord Deutscher Lloyd, the Hamburg-Amerika line, the Deutsche Bank, the Disconto-Gesellschaft, Siemens-Schuckert, Krupp, and Guison are subventioned by the Imperial Ministry of Foreign Affairs; furthermore they are helped by *a kind of industrial espionage,* as well as by guarantees and subsidies. "Germany was 'in a blue funk' about her commerce. What would become of Essen, of Gelsenkirchen, of all Westphalia, if the Roumanians, Greeks, and Serbs were to order their cannon, rails, or locomotives from Glasgow or Creusot? War appeared preferable to

Germany than a huge commercial crash, and the iron hand replaced the velvet glove." "Little by little the idea of a necessary war—a war almost to be wished for—became the desire of the working classes; failing it, they might starve, and their employers, the capitalists, be ruined." "After the great war is over the commercial war will be on us again. We must prepare *now*."

To this essay there follow some interesting articles by M. Delloye, by M. Ernest Fourneau, director of the Laboratory of Therapeutic Chemistry at the Pasteur Institute, M. Justin Dupont, Prof. Wahl of Nancy, M. Legouëz, and M. Ribes-Christophle. Among other observations we note one stating that French manufacturers usually only keep pace with current demand for goods; when a period of prosperity sets in, he cannot supply the increased demand, and his customers are driven to buy German goods; for Germans have always reserve plant ready for an emergency. For this reason they are able to execute orders more quickly; what it takes three months to supply in France can be delivered from Germany in a fortnight. M. Fourneau gives much interesting information on German drug manufacture; he concludes: "You know that fraud and slimness pass in Germany for quasi-virtues. . . . Germany, after having tried to frighten its adversary by its terrifying appearance, knows well how to appear humble, insignificant, and invisible." M. Dupont directs attention to the enormous task before the Allies of overtaking the German colour manufacture, which has been elaborated during the past forty years. Drugs, dyes, and explosives are so interlaced that the by-products of one manufacture often serve as the raw material of the others. M. Ribes-Christophle treats of German commerce in Argentina. False labels for goods, and adulteration are common. German firms, too, supported by their banks, *i.e.*, by the Central Government, sell at first at a loss, until they have killed out competitors. Their banks, of which there are branches in Argentina, act as company-promoters.

The impression gained from these articles is that German trade is largely fraudulent, sometimes honest, always methodical; that it is regarded as the duty of the State to support it by all means, moral and immoral; and that France must take steps to exclude it if she is to retain her position as a manufacturing nation. What these steps are has not yet been indicated. We shall look forward with the utmost interest to their decision; but it should be one taken in concert with the Allies.

WILLIAM RAMSAY.

PROF. PAUL EHRLICH.

ONLY recently we lost Löffler, one of the pioneers of modern bacteriology, and now Paul Ehrlich has passed away. He died on August 20, as all good workers might wish to die—suddenly in his laboratory, in full harness, and before the rust of age had dimmed his powers.

Born in 1854 at Strehlen, in Silesia, of Jewish parents, he was one of the many distinguished Hebrews who have contributed to make Germany's fame what it is in the world of science and art. He was educated at the Gymnasium at Breslau, and afterwards at the Universities of Breslau and Strasburg, where he graduated in medicine. From the outset of his career he took the deepest interest in the chemical relationships of living matter and in the affinities of various reagents for living cells. One of his earliest researches was upon the effects of certain aniline colours upon living tissues, and he devoted much attention to staining methods, devising new stains, and Ehrlich's hæmatoxylin and Ehrlich's triacid stain are stock solutions in the present-day biological laboratory. An investigation on staining methods for the tubercle bacillus led to the discovery that certain dyes possessed a peculiar affinity for this bacillus, and this fact tinged his whole philosophy, and suggested the conception of the specific affinity of certain chemical groups for particular cells and tissues.

He carried out pioneer work in hæmatology, differentiating and classifying the various forms of leucocytes or white blood-corpuscles.

His bent now turned largely on chemical lines. Diphtheria antitoxin had been discovered by Roux and Behring, but discrepancies in its standardisation came to light, and Ehrlich set himself to elucidate the cause of these discrepancies. As an outcome of this work a method of standardisation was evolved which exists to this day, and the strength of diphtheria antitoxin is now practically always described in Ehrlich "units." This work led on to an investigation of the mode of genesis of antitoxin, and the publication of the now famed "side-chain theory" of the formation of anti-bodies in general.

Ehrlich also performed some notable researches on cancer, and developed the atreptic theory of certain forms of immunity, but this investigation was dropped before long, probably because he foresaw that it was unlikely to bear fruit.

He now returned to some of his earlier work on the specific affinity of dyes and other substances for certain cells and micro-organisms, particularly the protozoan parasites. In trypan red he found a substance which attacked certain species of trypanosomes and cured the infection caused by them, but he failed to find a substance which would cure the allied trypanosomiasis in man. Besides dyes, a large number of complex organic compounds of arsenic and mercury were prepared and tested by himself and his assistants, and resulted in the discovery of "606," or salvarsan, as a cure for syphilis.

These are some of his achievements. Not only have his discoveries already benefited mankind in the direct alleviation of human suffering, but his researches into the perplexing phenomena of immunity and chemo-therapy have opened the way for further discoveries in these directions. He must be regarded as a pioneer who has carved the first track through that dense forest of the Unknown, which the worker of the future, following

in his steps, will widen into a broad highway. Ehrlich was honoured by almost every university. He was Croonian lecturer of the Royal Society, and joint recipient with Metchnikoff of the Nobel prize, and his genial and striking personality was well known to British bacteriologists. In 1897 he was created Geheimrath, and in 1911 Wirklicher Geheimrath.

In the present strife of nations, we British will be the first to recognise that in the death of Paul Ehrlich a great man, worthy to be ranked with Pasteur, Lister, and Koch in his particular line, has passed away.

FREDERICK VICTOR DICKINS, C.B.

WHEN it became known to the friends of F. V. Dickins only a few days ago that a serious surgical operation had been suddenly called for, they sadly recognised that the end was probably not far off. Heart failure and the weight of over seventy-seven years closed his life on Monday, August 16.

Dickins was a remarkable man and had enjoyed a singularly varied and interesting life. Medicine first attracted him, and after graduating (1861) M.B. and B.Sc. in the University of London, he served for five years in the Navy between China and Japan. Then he took up law, and having been called to the bar in 1870 he practised in Yokohama for many years, and at this time began to give increasing attention to those Oriental studies which occupied him to the end of his life. In 1882 he became Assistant Registrar to the University of London, the late Arthur Milman being then Registrar. It was in this capacity that he became known to the large circle of eminent men connected with the university, and especially the examiners. Soon after his appointment the practical examinations of the university were considerably amplified in scope, and examinations in practical physics were introduced for the first time. It is not too much to say that the successful conduct of these examinations at the outset was largely due to the energy of the assistant registrar, who not only obtained the necessary apparatus, but set up much of it with his own hands when required for the use of the examiners. A technical assistant for this business was employed later. He succeeded Milman as registrar in 1896.

Dickins read widely and was familiar with the chief advances in physical and natural science, in which he took great interest. But his speciality was Japanese and, to a less extent, Chinese language and literature. After retiring from the registrarship in 1901 his leisure was therefore naturally occupied with his favourite studies, and we owe to his pen the two volumes of "Primitive and Medieval Japanese Texts," published by the Clarendon Press in 1906, and the translation of the charming Japanese "Story of a Hida Craftsman" in 1912, besides other works.

Dickins was a member of the Athenæum, but owing to failing health and distance, he retired from the club two years ago.

NOTES.

THE Royal Society is compiling a register of scientific and technical men in Great Britain and Ireland, who are willing to give their services in connection with the war. The register will be classified into subjects, and will ultimately constitute a large panel of men of standing, whose services will be available whenever any Government department or similar authority requires specialist assistance. The register is being co-ordinated with those independently compiled by other societies and institutions, but the Royal Society would be glad to have applications for forms from such members of the staffs of colleges and technical institutions as have not yet been registered by any society. The Royal Society is also drawing up, with the co-operation of the principal societies and institutions, a list of scientific and technical men actually on active service in His Majesty's forces. Any names, with rank and unit, for this list will be gratefully received by the secretaries at Burlington House, Piccadilly, W.

WE learn that Mr. M. T. Dawe, formerly a member of the gardening staff of the Royal Botanic Gardens, Kew, sometime Superintendent of the Botanical and Forestry Department, Uganda, and lately Director of Agriculture, British East Africa, has been appointed Agricultural Adviser to the Government of Colombia.

THE Chilean war vessel *General Baquedano*, which has recently returned from Easter Island, has brought news of the Easter Island Expedition of Mr. and Mrs. Scoresby Routledge up to June 8, at which date the expedition had been fourteen months in residence, during which time a careful survey had been made of the existing antiquities and such ethnographical information collected as is still available.

THE Hutchinson medal for research, of the London School of Economics and Political Science, has been awarded to Mr. R. C. Mills for his thesis on "The Colonisation of Australia, 1829–1842: the Wakefield Experiment in Empire Building," and the Gladstone Memorial prize to Mr. C. M. Jones.

WE regret to hear that Capt. W. E. G. Atkinson, son of the late Prof. Atkinson, of the Staff College, Camberley, was killed at the Dardanelles on August 6. Capt. Atkinson was educated first at Clifton College and afterwards at the Wye Agricultural College, where he had a very successful career. In 1902 he left Wye and proceeded to the Rothamsted Experiment Station as a post-graduate research worker. Prior to that date there had been very few such workers at any time, and none for a number of years. Capt. Atkinson was the first of the modern contingent, which has since swelled considerably. He worked with Mr. Hall on the problem of quality in wheat. Millers and farmers alike recognised the marked differences between varieties of wheat, some—the so-called strong wheats—giving grain of high baking quality, possessing great capacity for forming large, well-piled loaves, while, others—known as weak wheats—gave rise to squat, heavy-looking loaves, much less attractive in appearance. No satisfactory

chemical work, however, had been done to explain the cause of these differences; a certain number of analytical investigations had been made, but these aimed rather at discriminating between the strong and the weak wheats than at the elucidation of the cause of strength. Under Mr. Hall's guidance, Atkinson worked out the various analytical data for a series of wheats of known baking properties, and was thus able to eliminate the unsatisfactory methods, and fix attention on the better ones; in particular it was demonstrated that the percentage of nitrogen largely, but not entirely, affords a measure of strength in wheat. This information has proved valuable in subsequent studies of the problem. Capt. Atkinson then took an appointment as lecturer in agriculture at Reading, but later on went in for actual farming, a course he had always desired to follow.

CAPTAIN ARTHUR KELLAS, R.A.M.C. (T.F.), who was killed in action at the Dardanelles on August 6, was senior assistant physician at the Royal Asylum, Aberdeen. He was a graduate of the University of Aberdeen, having taken the degrees of M.B. and Ch.B. in 1906, and that of D.P.H. in 1907. In 1914 he obtained the new diploma of psychiatry in the University of Edinburgh. His tenure of office at the Royal Asylum was a strikingly successful one; on both the therapeutic and the administrative sides he evinced gifts of no ordinary type. His work in the Physiological Laboratory of the University was characterised by qualities of a very high order, and marked him out as a man of notable promise as a scientific worker. Added to this his singular personal charm has made the sudden ending of his career to be widely and deeply deplored.

WE regret to note the death, on August 20, at the age of fifty-one, of Mr. W. Hugh Spottiswoode, son of Mr. William Spottiswoode, a former president of the Royal Society. Mr. Hugh Spottiswoode was for a time a manager of the Royal Institution, to which, in 1899, he presented his late father's collection of physical apparatus; he later gave his father's mathematical MSS. to the London Mathematical Society.

THE death is recorded in the *Victorian Naturalist* of Mr. F. Manson Bailey, of Brisbane, at the age of eighty-eight years. Mr. Bailey, who died on June 25, was Colonial Botanist for Queensland from 1881 until within a short time of his death.

WE regret to record the death, on August 14, at the age of sixty-one years, of Capt. E. W. Owens, chief examiner of masters and mates.

A BRONZE bas-relief—the work of Mr. S. N. Babb—is about to be erected in St. Paul's Cathedral in memory of Captain Scott and his companions who perished in the Antarctic. At the request of the committee responsible for the memorial an inscription for the memorial has been written by Lord Curzon, which reads as follows:—"In memory of Captain Robert Falcon Scott, C.V.O., R.N., Dr. Edward Adrian Wilson, Captain Lawrence E. G. Oates, Lieut. Henry R. Bowers, and Petty Officer Edgar Evans, who died on their return journey from the South Pole in February and March, 1912. Inflexible of purpose, steadfast in courage, resolute in endurance in the face of unparalleled misfortune. Their bodies are lost in the Antarctic ice. But the memory of their deeds is an everlasting monument."

IN addition to his name being expunged from the list of honorary members of the laryngological societies of Vienna and Berlin, in consequence of his having protested in a letter to the *Times* against the barbarities of Germany in the war, the name of Sir Felix Semon has been removed from the *Internationales Centralblatt für Laryngologie*, which journal he founded twenty-five years ago. We learn from the *British Medical Journal* that, in consequence of this action, all the British editorial contributors to the *Centralblatt* who have had an opportunity of seeing the declaration have withdrawn their names from and resigned their editorial connection with it. Among these are Dr. Peter McBride, Dr. H. J. Davis, Dr. Logan Turner, and Dr. Watson-Williams. They have taken this course as the only effective protest open to them against the affront to a British colleague for whom they entertain the highest respect involved in the removal of his name from an international journal founded by him: Their American collaborator, Dr. Emil Mayer, has also severed his connection with the journal as a protest against the step taken by the editor and publisher.

WE notice, from the second edition of the "War List" of the Manchester Municipal School of Technology, that the following members of the staff of the school have joined H.M. Forces on active service, in addition to those named in NATURE of July 15th:—Prof. A. C. Dickie, department of architecture, 2nd Lieut. Manchester University O.T.C.; F. S. Sinnatt, department of applied chemistry, Capt. Manchester University O.T.C.; F. Bowman, department of mathematics, Naval Instructor; J. L. Owen, department of applied chemistry, Lce.-Corpl. R.A.M.C. Sanitary Corps; W. W. Stainer, department of electrical engineering, 2nd Lieut. 3/4th Batt. Royal Sussex Regiment.

THE twenty-sixth annual general meeting of the Institution of Mining Engineers will be held at Leeds on September 15, when the following papers will be communicated:—Some effects of earth-movement on the coal-measures of the Sheffield district (South Yorkshire and the neighbouring parts of Derbyshire and Nottinghamshire), Prof. W. G. Fearnsides; Compressed air for coal-cutters, S. Mavor; Gas-producers at collieries for obtaining power and bye-products from unsaleable fuel, M. H. Mills. During the meeting the Institution medal for the year 1914–15 will be presented to Dr. J. S. Haldane, in recognition of his investigations in connection with mine air.

THE annual exhibition of the Royal Photographic Society is being held as usual (it closes on October 2) at the Suffolk Street Galleries, and although it of necessity suffers in some ways by reason of the war, special efforts in possible directions have, we think, brought the interest of the show fully up to its usual level. The contributions from America are note-

worthy and various. The Mount Wilson Observatory shows photographs of vortex rings in water and in air, and compares them with hydrogen flocculi about sun-spots, and spectra of spots showing the displacement, and the tripling and quadrupling of lines due to the magnetic field. Photographs of various zodiacal lights, in which the effect of the exceedingly feeble luminosity is greatly increased, are from the University of Arizona. The various methods of discovering double stars employed at the Harvard College Observatory, and summaries of the results, are made interestingly clear by the contributions of Prof. Pickering. Dr. Nutting, of the Kodak Laboratory, sends results of lens testing, in which the figures of a luminous point yielded by lenses at various angles from the axis and different minute distances from the focus are remarkably well defined though magnified 60 diameters. An excellent series of the effects of spark discharges on photographic plates by Dr. Hoffert, results obtained with a "micro-kinetograph" apparatus by Mr. Martin-Duncan, high-power photographs of diatoms by Mr. E. A. Pinchin, and a selection of high-speed photographs by Dr. Abrahams, deserve special notice in the scientific and technical section. The natural history, colour, and other sections show no falling off in interest.

Two waterspouts were seen off Dymchurch in Kent on August 16 shortly after 1 p.m., and they are described in the *Times* of August 19 by Rev. Henry Harries. The morning had been fine, and a thunderstorm was in progress at the time. The waterspouts were of the usual kind—a long narrow funnel connected a dark cloud with the surface of the sea, at a point where the surface was violently agitated. In one case, the funnel was seen to be in rapid rotation, while downward and especially upward movements were also discernible. The waterspout at sea and the tornado on land are manifestations of great instability of the atmosphere in a vertical direction, caused either by an abnormally warm surface layer of air or an abnormally cold layer at the cloud level. The former cause is common in summer; the latter occurs both in summer and winter, and is usually associated with a "line-squall" or V-shaped barometric depression. The waterspout shows the track along which surface air passes spirally upwards to restore equilibrium. The commotion of the sea is due to the exceedingly violent character of the phenomenon. The funnel itself is probably composed partly of moisture condensed out of the air by the sudden diminution of pressure which occurs, and partly of sea-water in the form of spray. Sometimes the middle portion of the visible funnel is absent, but there must be in that case a corresponding complete funnel of rotating air from the surface to the cloud.

A USEFUL article on the war and English chemical industry is contributed to the August *Fortnightly Review* by Mr. John B. C. Kershaw A comparative analysis is given of the British and German exports of manufactured chemicals, showing that whereas the bulk of the British exports consist of heavy chemicals and "crude products," the German exports to this country, which have a value twice that of the British exports, consist mainly of fine chemicals, dyes, and pharmaceutical products. In the manufacture of the former a minimum of skilled labour and supervision is required, whilst in the German manufactures the opposite is the case. Mr. Kershaw again emphasises the fact that in Germany the directors and managers of chemical works are men whose business training has been superimposed on that obtained at a university, and who therefore have a thorough knowledge of the scientific side of the business, and realise the necessity for calling into their councils the best scientific and engineering knowledge available. One of the most important results of this is that they are not impatient of the time taken or success achieved by research work, and their knowledge of chemistry renders them less liable than inexperienced men to expect impossible results. A second factor of importance in the success of the Germans in the manufacture of fine chemicals is that resulting from the cleanliness, orderliness, and discipline of the German worker. This is attributed in no small part to the training gained during the period of military service. The article closes with a discussion of the prospects for the industry of fine chemicals and dyes in this country in the future, when the war has ended and the Germans again become active competitors.

THE arboretum at Tortworth Court is well known to be one of the finest in the British Isles. One feature of particular interest lies in the fact that the collection is entirely the work of the present Earl of Ducie, who has been planting assiduously for sixty or more years, and many rare species are here represented by the finest specimens of their kind in the kingdom. As the grounds rest on mountain limestone and Old Red Sandstone a useful choice of sites is afforded, and on the latter rhododendrons and allied plants thrive. An interesting account of the collection is given by Mr. W. J. Bean in *Kew Bulletin* No. 6, 1915, and particulars of the more notable specimens of oaks, chestnuts, maples, etc., are recorded, the latter being a remarkably fine collection. The golden chestnut, *Castanopsis chrysophylla*, from California, is one of the most famous trees, and was planted by Lord Ducie sixty years ago. The Antarctic "beech," *Nothofagus obliqua*, from southern South America, is also forming a handsome tree. The famous Tortworth sweet chestnut, with a trunk about 51 ft. in girth, is still alive, and is the tree under which King John is said to have held council; as early as Stephen's reign Evelyn says it was known as the Great Chestnut of Tortworth.

VALUABLE work is being undertaken in studying the characters of the sugar-canes cultivated at Sabour by Mr. E. J. Woodhouse, economic botanist to the Government of Bihar and Orissa, and Mr. S. K. Basu, assistant professor at the Agricultural College, and their results up to the present are published in Memoirs of the Department of Agriculture in India, vol. vii., No. 2. As in work of a similar character on other plants, the authors find that it is necessary to study varieties which have been derived from a single plant culture. Twenty-one different characters, relating to field appearance, the leaves, and the

stripped canes, have been examined, and the results tabulated for a great number of individuals. The chemical characters have also been examined by Mr. C. Somers Taylor, agricultural chemist to the Government. It has been found that four definite groups can be obtained from chemical considerations that coincide with four of the groups into which the canes have been classed botanically, so that the botanical and chemical characters appear to be closely allied. Agricultural rather than minute botanical characters have been studied. The records obtained are not only of interest as being the first attempt in India to propagate sugar-cane by the method of pure-line cultures, but also because they will prove useful in studying the behaviour of these canes under different conditions of soil and climate, and will provide information in the future on the subject of deterioration.

THE Agaveæ of Guatemala form the subject of a well-illustrated paper by Dr. W. Trelease, the recognised authority on these fibre-producing plants, in the Transactions of the St. Louis Academy of Sciences, vol. xxiii., No. 3. Formerly two species of Agave and two Furcræas were ascribed to Guatemala. One of the former, however, *Agave sartorii*, is Mexican, while *Furcraea selloa* proves to be a native of Colombia. Dr. Trelease records no fewer than nineteen species of Agave and five of Furcræa from Guatemala, all except the two previously recorded being new, and described and figured for the first time in the paper. A fact of some geographical interest is that the spicate subgenus of Agave, Littæa, does not appear to reach into Central America any more than it does into the West Indies. The species which have been collected mainly by Dr. Trelease are based almost entirely on leaf characters, but these are always found to afford satisfactory distinguishing features in this genus. The habit of the various species and their leaf characters are well shown in the thirty excellent plates.

A USEFUL article on the European pines, their commercial importance and their relationship to British forestry, is published in *Kew Bulletin* No. 6, 1915. Ten species of Pinus are discussed, *P. canariensis* being included. *P. laricio*, *P. pinaster*, and *P. sylvestris* are the species of most value for planting in Great Britain. Under the maritime pine (*P. pinaster*) an account is given from the Consular Report of the remarkable success which has attended the planting of this species in the Landes of south-western France, and of the value both of the turpentine and the timber.

THE remarkable parasitic genus Phelipea (Orobanchaceæ), containing three species all with brilliant scarlet flowers, is described and figured in *Kew Bulletin* No. 6 by Dr. Stapf. *P. foliata*, the species figured, flowered at Kew both in 1914 and this year, and formed a striking object with its large flowers springing from among the silvery leaves of its host plant, *Centaurea dealbata*. The history of the genus Phelipea is somewhat involved, and the synonymy, which is in consequence very complicated, has been satisfactorily elucidated in the present paper. Dr. Stapf describes a new species, *P. boissieri*, distinguished especially by its bifid calyx and bearded anthers. The genus is a native of Asia Minor, the Caucasus, and northern Syria.

THE July number of the *Scottish Naturalist* is entirely devoted to the report, by Miss Evelyn Baxter and Miss Leonora Rintoul, "On Scottish Ornithology in 1914," but the interest of its contents will appeal to a wide circle of readers, and especially those concerned with the problems of migration. During the last few years, Fair Isle, lying midway between the Orkney and Shetland Islands, has become an observation station of the first importance, not only because many additions to the list of our British birds have been made from records obtained from this small area, but also because of the facilities it affords, from its small and isolated area, for the analysis of the components of passing streams of migrants. The most important addition to the Scottish avifauna during 1914 was that of the Aquatic Warbler (*Acrocephalus aquaticus*), which was obtained on Fair Isle on October 23rd. In their summary of migratory movements, the authors record "an enormous immigration of woodcock to Fair Isle" on March 26, followed on March 30 by a further influx. While all will feel grateful to the compilers of this most admirable report, many will regret the assumed necessity for adopting the most up-to-date vagaries in nomenclature, especially such as *Coccothraustes coccothraustes coccothraustes*!

IN the Annals of Tropical Medicine and Parasitology for July (vol. ix., No. 3), Messrs. Warrington Yorke and B. Blacklock deal with the bionomics of the tsetse-fly, *Glossina palpalis*, which conveys human trypanosomiasis and sleeping sickness, and with the reservoir of the human trypanosome, in Sierra Leone, and Dr. Fantham gives an account of a spirilliform micro-organism, *Spirochaeta bronchialis*, which produces bronchial affections in the Sudan and other parts of the world. It is distinct from the spirochaetes which are of frequent occurrence in the mouth. The articles are illustrated with numerous plates.

WE have received the *Review of Applied Entomology*, series B, Medical and Veterinary, for July (vol. iii., series B, part 7). It contains a valuable summary of the current literature dealing with the part played by "insects" in the propagation of diseases in man and animals, such as plague, malaria, sleeping sickness, and Texas fever.

A SUMMARY of rainfall, mean temperature, and sunshine for the second quarter, April, May, and June, 1915, has been published as an appendix to the Weekly Weather Report by the Meteorological Office. Comparison is made with the thirty years' average, 1881 to 1910, and the values are given for the several lustra during this period as well as for the individual years from 1911. The quarter was dry and sunny, with normal temperature. For the current year the rainfall was 77 per cent. of the average over the eastern districts of the British Isles, the percentage ranging from 59 in the north-east of England to 102 in the south-east of England. Over the western districts,

including Ireland, the rainfall for the quarter was 75 per cent. of the average, the percentage ranging from 69 in the north of Ireland to 88 in South Wales and the south-west of England. The mean temperature was 1° above the average in the south of Ireland, whilst in all other districts the departure from the average, plus or minus, did not amount to 0·5°. The duration of bright sunshine over the eastern districts was 109 per cent. of the average, whilst in the western districts it was 105 per cent. The only districts with a deficiency of sunshine were the south-west of England, the south of Ireland, and the English Channel; in the latter district the duration was only 82 per cent. of the average.

THE rainfall table for July in *Symons's Meteorological Magazine* shows the month to have been very wet in nearly all parts of the British Isles. The data are only for a few stations in comparison with those which will be given later by the British Rainfall Organisation. At Mickleover Manor in Derbyshire the fall was 250 per cent. of the average, the actual excess of rain being 3·84 in. At Hull the rain was 240 per cent. of the average, and at Geldeston it was 233 per cent. The only stations in the table with a deficiency are Newcastle, Aberystwyth, and Wick. In the Thames Valley, where the rainfall is graphically shown by the usual monthly map, the measurement exceeded 5 in. over a fairly large area. Over the British Isles the rainfall was 148 per cent. of the average, the fall in the different parts of the kingdom being, England and Wales, 155; Scotland, 125; and Ireland, 158 per cent.

La Nature (July 31) contains a highly interesting article on the manufacture of shells, the various processes being illustrated with excellent diagrams and photographs. The author points out that the war has already radically changed our conceptions on many points; that no longer does success depend so much on the number of combatants as formerly, and that victory is more assured to that adversary which is capable of expending most shells in the least space of time, and it is therefore towards the factories that all considerations converge. Reference is made to the return to the factory of munition workers from the front, there having been a steady exodus in this direction in France since the first months of the war, but necessarily the reorganisation of the factories has had to precede the recall of the workmen. After a lucid description of the various processes through which the shells for the celebrated 75 mm. gun pass, the question of inspection is detailed. Out of every thousand, twenty are examined; if one is defective another twenty are selected, and if another fails the whole batch is examined one by one. Finally, twelve are taken and tested on the firing ground, being afterwards examined for any deformation they have undergone.

Engineering for August 13 has an article on the Port of London Docks and traffic. Important work is being done for the extension of the Royal Albert Dock southwards. The plans of the new work have been altered. The dry dock is now to be made 750 ft. long, and the main dock is to be increased in depth from 35 to 38 ft. The entrance-lock, 800 ft. long by 100 ft. wide by 45 ft. depth below Trinity high water, is making very good progress; the wall on the north side is completed, and 650 ft. of the south wall is built almost to coping level. The main basin is to have an area of 65 acres, and more than two-thirds of the excavations have been made. The south quay has been practically finished, and 670 ft. of the north quay is nearing completion. The trench excavations for the north wall of the dry dock have been made for a length of 580 ft., and a length of 230 ft. of concrete walling is in progress. The passage connecting the new and the old docks is progressing. The lock-gates, caisson, and bascule and swing-bridges are being constructed by Sir William Arrol and Co., Ltd., of Glasgow.

ALTHOUGH amongst the ordinary chemical elements potassium and rubidium are the only ones which have shown a measurable amount of radio-activity, it has not yet been proved conclusively that the small amount of β-radiation observed in the case of these substances has not been due to radio-active impurities. The most satisfactory proof of the radio-activity of these elements would be to trace their radio-active products. According to the laws that expulsion of an α-particle decreases the atomic weight by 2, and removes the product two places to the left in the periodic table of elements, while expulsion of a β-particle, while producing no appreciable change in the atomic weight, moves the product one place to the right, potassium should produce an element with the chemical properties of calcium, but with atomic weight 39·15, and rubidium an element like strontium, but with atomic weight 85·45. An investigation directed towards the detection of these new elements has been proceeding for some time at the radiological laboratory of the Scientific Society of Warsaw under Dr. H. Lachs, and a preliminary communication on the subject was made to the society at the meeting on March 4, but no definite conclusion had at that date been reached.

AN interesting new method of standardising normal and decinormal solutions of acid used in volumetric analysis is described by Mr. Francis D. Dodge in the *Journal of Industrial and Engineering Chemistry* (vol. vii., No. 1). The article is reprinted in the *Chemical News* (August 6). Use is made of potassium hydrogen phthalate, which is easily prepared in a pure state by dissolving phthalic anhydride in aqueous potassium hydroxide and recrystallising the product. The salt, when dried at 110°, is anhydrous, $C_8H_4O_4.HK$, and behaves like a monobasic acid, the end-point in the titration being remarkably sharp.

OUR ASTRONOMICAL COLUMN.

THE AUGUST PERSEIDS.—One result of the recent observations of this shower will be the determination of a large number of real paths of meteors not belonging to the Perseid swarm. The minor radiants visible between August 10–20 were very numerous and interesting. In several cases, however, the meteors doubly observed do not work out very well, and these await further investigation. Some of the other observers have not yet sent in their results.

A splendid meteor was seen over the southern region of Scotland on August 13 at 9h. 16m. It was fortunately recorded by Mr. A. King from near Edinburgh, and Mrs. F. Wilson saw the object near the N. by W. horizon, though her station at Harrow-on-the-Hill was distant about 370 miles from the place of the meteor.

The following are the particulars of fifteen non-Perseids seen during this year's display and computed by Mr. Denning:—

Night	G.M.T.	mags.	Height at first	Height at end	Path length	Velocity per sec.	Radiant point	Meteor's name
	h. m.		m.	m.	m.	m.	° °	
Aug. 10	9 33	1>1	68	52	154	38	40+29	Muscid
	10 23½	2½-2	84	45	52	20	290+11	ε Sagittid
	11 0½	3-2	81	55	63	42	40+38	β Perseid
Aug. 12	10 18	2½-2	74	42	32	16	281+43	α Lyrid
	10 18	2½-2½	80	55	67	—	46+44	α Perseid
	10 44½	2-2	56	38	192	35	39+7	α Cetid
	11 28	2-1	77	54	32	40	315+13	Delphinid
Aug. 13	9 16	♀>♀	52	43	19	19	280-13	δ Antinoid
	10 40	4-2	69	46	28	56	300+20	η Sagittid
	10 40½	2-2	68	51	27	36	332+10	ε Pegasid
	11 11	5-2	77	50	44	28	343+14	α Pegasid
Aug. 14	10 14	4-4	67	52	24	25	194+64	ε Ursid
	10 25	1>1	49	41	82	16	153+41	μ Ursid
	10 36½	2-1	67	61	7	11	302+13	α Aquilid
Aug. 18	10 40	3-2	59	52	29	58	72+41	η Aurigid
Aug. 19	9 20	>1	79	57	65	44	135+59	υ Ursid

THE TUBE ARC SPECTRUM OF IRON.—The installation of a 100-kw. transformer in the Pasadena laboratory has enabled Dr. Arthur S. King to extend his investigation of the spectrum peculiarities of the tube arc, and he has now carried out a comparison of typical iron lines in tube-arc and spark spectra. In these later experiments, according to a paper in the *Astrophysical Journal* for June, the best results are stated to have been obtained when energy was being supplied at the rate of 40 kw. at the moment of rupture of tube (*i.e.* formation of tube arc), the exposure being made whilst the current fell from 1000 to about 600 amps.; the second order of a 4-inch plane grating was used in the vertical telescope with an objective of 30 ft. f.l., the dispersion being 0·9 A. per mm.

The tube arc is found to resemble the disruptive spark in imparting unsymmetrical structure to many of the stronger lines, the magnitude of the effect being closely related to their furnace and pressure classification. The least affected lines are the flame lines. In the spark, very curiously, the enhanced lines remain symmetrical. The conclusion is reached that strong electrical excitation, together with high vapour density, produce displacements resembling the effect of pressure, and the suggestion is advanced that the *density of high-speed electrons* is the operative common factor.

A brief account of the same investigation forms No. 9 in the series of Communications from the Mount Wilson Solar Observatory to the National Academy of Sciences (U.S.A.) Proceedings, vol. i., p. 371, June, 1915.

CONTROL OF AUSTRALIAN OBSERVATORIES.—From an Australian daily contemporary we learn that the Public Service Commissioner has recommended the transference of the Victoria Observatory to the Federal Government on the grounds that it is a *national*, and not a *State*, institution. It is added that there is a consensus of opinion among the astronomers of the various States that it would be well to hand observatories over to Federal control.

PROPER MOTIONS OF THE STARS BY STEREOSCOPE.—M. J. Comas Solà (*Comptes rendus*, vol. clxi., p. 121, August 9, 1915) describes an interesting attempt to employ the stereoscope in the study of stellar motions. By means of a camera, aperture 160 mm., f.l. 800 mm., mounted on a 6-in. equatorial as finder, photographs of the globular cluster M. 11 (Aquila et Antinous) were taken on July 12, 1912, and again on July 20, 1915. The negatives were then viewed in an ordinary stereoscope with striking results. On a surface 20 degrees square, no fewer than 200 stars exhibited sensible proper motion, and it proved specially easy to pick out groups of stars having common or related proper motions. It is suggested that it should not be difficult to obtain quantitative results in employing a stereocomparator or stereometer. The preliminary qualitative survey indicates that the greater part of the stellar trajectories in the region studied make a large angle with the mean line of the Milky Way.

SOLAR VORTICES.—Having established beyond doubt the existence of the Zeeman effect due to the magnetic field in sun-spots, Prof. George E. Hale has now been able to trace the law of rotation in spot vortices by some highly significant observations communicated to the National Academy of Sciences, U.S.A. (Proc., vol. i., p. 382). The typical sun-spot group consists of two spots of opposite magnetic polarity, and thus rotating oppositely, lying almost parallel to the solar equator. The preceding spot is usually the dominant member, whilst the following spot may consist of small spots or be represented merely by flocculi, the characteristic feature of the group being the presence of magnetic fields of opposite polarity in the regions of its eastern and western extremities. Briefly, the present results indicate that the direction of rotation depends on the phase of the spot cycle, thus in *low latitudes* (end of cycle) the rotation in the spot vortex (preceding spot) is the same as in a terrestrial tornado, *i.e. anti-clockwise* in the N. hemisphere, but in *high latitudes* (beginning of cycle) the direction of rotation is the reverse; each spot belt is thus divided into two zones of approximate mean latitudes of 9° and 23° respectively.

In collaboration with Mr. George P. Luckey, Prof. Hale has been conducting some novel laboratory experiments (Proc. Nat. Acad. Sci., vol. i., p. 385) in vortex motion; means have been successfully devised for reproducing the characteristic features, not only of spot vortices, but also to some extent the movements in flocculi.

LIFE-HABITS OF THE OKAPI.

DR. CUTHBERT CHRISTY, known to a good many people by his medical research work and botanical collecting in West and in Central Africa, recently spent several years in the service of the Belgian Congo, and was directed, amongst other things, to give careful study to the okapi in the forests of north-east Congoland. The result is that we have for the first time an accurate and detailed description of the life habits of the okapi. Dr. Christy has also, I believe, been the first to bring to Europe the "soft parts" of this Giraffid. A few years ago this was what many zoologists were longing for; the soft parts (intestines, genital organs, etc.) of the okapi were needed to supplement the study of its skeleton and enable us to fix with precision its position in the giraffe family, and perhaps the basal relations of that group with other Pecora.

Unfortunately, Dr. Christy arrived home (after running many war risks on the way) with his valuable cargo of specimens at a time when we were so completely engrossed by the war that little interest was aroused, and little attention was given to his remarkable researches. The comparative anatomists who might have examined his material are apparently absent from their usual seats of learning engaged in war business. I understand that Dr. Christy has placed the soft parts of his specimens in the British Museum (Natural History), and we may hope perhaps

that they will there receive examination at competent hands.

Dr. Christy adds his testimony to that of his predecessors in the same quest as to the "invisibility" of the okapi, whose markings and coloration—*pace* Colonel Theodore Roosevelt—so break up the surface of its large body and long legs as to cause it to fuse with the dark-brown, russet, white and yellow-white of the twigs and stems and leaf-stalks amongst which it moves. He also points out that the hoofs of the okapi are so closely pressed together that the footprint is almost like that of the single-toed donkey. On the other hand, he does not believe that the okapi feeds on the big leaves of the Sarophrynium (an amarantaceous plant), it merely resorts for concealment to these 6-ft. high thickets. Nor does it necessarily feed at night only, but rather in the early morning and late afternoon. It feeds chiefly on the small leaves and twigs of trees, which it "hooks down with its long, mobile tongue." It does not eat grass, but does browse on the coarse herbage on the outskirts of the forest. These notes are extracted from an extremely interesting article in the *Field* of July 10, which contributes likewise a good deal to our knowledge of the Bambute pigmies, almost the only foes the okapi has.

In connection with this subject might I again put forward the suggestion that the very puzzling remains of so-called "antelopes" recently found, not only in southern California, but actually in Maryland (eastern North America), may be the bones and teeth of primitive Giraffids and not of "elands" or Tragelaphs, as surmised by American zoologists. The nearest relation of the isolated giraffe group at the present day would seem to be the pronghorn of western North America. It is quite conceivable that the Giraffids may have arisen from the indeterminate Antilocaprid group (intermediate between the Deer and the Bovids) in North America, and thence have spread to north-eastern Asia and eventually to India, Persia, Africa, and southern Europe. There are giraffine remains found fossil in China, and north-west India would seem to have been the area of greatest variation and specialisation.

H. H. JOHNSTON.

THE SOUTH AFRICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.[1]

PRETORIA MEETING.

EXCLUDING the purely formal meeting of 1905, in which year we joined forces with the visiting British Association for the Advancement of Science, this is the second session of the association to meet in the Transvaal and the first to meet in Pretoria. Our association was started in 1903 at Capetown, and in 1904 the meeting was held in Johannesburg, but on that occasion one day was spent in Pretoria. This year we hold our meeting in what is now the administrative capital of the Union, but we are invited to spend one day in Johannesburg, visiting the Crown Mines, when visitors will have a favourable opportunity of seeing the conditions under which our staple industry is conducted, especially with regard to modern views on hygiene and the preservation of life.

The calm atmosphere of our association is especially suitable for discussions upon the broad principles underlying polity. In the present times these principles are being profoundly modified; old standards of government seem to be weakening day by day, and our association affords a common ground where tendencies can be examined for what they are worth, instead of through the distorting lenses of party passion.

[1] Abridged from the address of the president, Robert Thorburn Ayton Innes.

War and Science.

We meet this year under extraordinary circumstances, during a period of war unequalled in the history of mankind in its extent and intensity. A superficial view would be that our association has nothing to do with wars at any time, and should ignore the present war. This view would be entirely wrong. The war touches humanity at every point, in every interest. I am therefore going to deal with it, but in such a way that no one could say to which side my sympathies lean. I have, like everyone else, very decided views upon the rights and wrongs of the war, but these concern one of the aspects with which we as a scientific body have nothing to do.

A certain school of thought—not particular to any one nation—has praised the value of war as a discipline, and even as a moral force. Another school looks upon war as a curse for which no defence is possible. Science is impersonal, and looks merely to facts. Yet science cannot but feel degraded when it finds so great a part of its recent advances applied so freely and almost solely as aids to the destruction of human life. The pre-eminent inventions of our present generation—wireless telegraphy, the airship, the flying machine, the submarine, thermite, and other allied heat producers—seem to have found their culmination in use in war. How different is this from the ideal of the man of science—the most altruistic possible—the lightening of the burdens of humanity by the mastery of natural forces—the transformation of inanimate power to relieve mankind from arduous work—the conquest of pain and disease—the improvement of agriculture—and, by no means least, the enlargement of the human mind. Greek culture—that extraordinary efflorescence of a limited community of small cities, which we prize so highly to-day, and whose lesson seems to be valid for all time—we are told was only possible because the Greek civilisation was built upon slavery; the helot was the pivot on which it turned. The man of science looks forward to a period of leisure and culture equally founded upon a slavery, but not upon the unwilling slavery either of man or beast, but upon the willing slavery of machinery and of the powers of nature harnessed for use.

An increasing and unfaltering search for truth, with a belief in the betterment of humanity through knowledge, is the ethical basis of science, and none other. If science could only serve material ends—the increase of money—profit, or serve to rivet the domination of one State over another—then it would be worthless; nay, it would be unclean.

We perceive to-day that when any one nation deliberately uses the resources of science as an aid to war, a burden of terrible import is thrown upon other nations. And herein is another apparent great evil of science, because its advance makes war both more terrible and more destructive. I say an apparent evil, because if it is not controlled it will lead to exhaustion, and so limitation will have to come by necessity. I believe that in earlier ages the individual, or at least the family, the patriarchal group, was to a great extent, like a nation is now, each a law unto itself, and it was only as weapons got more expensive and deadly that the small group was willing to abandon the right of private revenge or redress. In yet later ages the baron in his great castle could defy the king, but the invention of the cannon and the control of the manufacture of gunpowder by the king made even the most powerful barons willing to accept the king's peace. To-day we would not tolerate any man or group of men turning their buildings into fortresses; to-morrow, I hope, I believe, that nations, or a federation of nations, will likewise refuse to allow any other

nation or group of nations to arm themselves to such an extent that it or they can become a menace to the peace of the rest of the world.

Organisation.

There is another and more positive lesson for us in the present war. It shows the power of organisation. We see two Empires, but roughly one—the Germanic nation—at war with four other great nations, which has so developed its resources and organised them, that it can stand the strain of such a war that 25,000,000 picked men have already been in the field. However deplorable this may be from ethical and economic points of view, it at least does show what science and organisation can do to-day. I suppose that, one way and another, 50,000,000 of the human race are either fighting or supplying food and munitions of war to the combatants. And no sign of exhaustion is as yet clearly discernible. When we remember that war in the olden days was conducted with small armies and only during a portion of the year, we realise the maleficent power that science has placed in the hands of mankind. It needs careful regulation. This power for evil might only have been potential, it might have remained undeveloped; but we have found to our loss that at least one nation has developed and organised itself, by the aid of science, to such an extent that it dares to declare itself independent not only of the power, but even of the opinions of the rest of the world.

The lesson will not be lost. If the deliberate organisation of a single nation can result in such power, then every nation must organise. Not necessarily organise for war, for death; but organise for peace, for life.

Laissez faire passed into twilight when the great war commenced. We have to turn our eyes in the direction of the rising sun of an organised humanity, of which we perceive the dawn already. Then the advancement of science will surely have no sinister meaning. We pray that the advancement of science will be identical with the advancement of humanity.

Progress of Astronomy.

I am perhaps fortunate in belonging to a branch of science which has nothing to do with war. Therefore the astronomer can regard war with a sense of detachment; and to those who know the stars, the immensity, the eternity of the universe, its increasing grandeur, war seems trivial and foolish—the work of unbalanced minds.

I spoke of one of the aims of science as the enlargement of the human mind. Although every branch of knowledge—a word which I take to be nearly synonymous with science (science being co-ordinated knowledge)—leads to the extension of the human mind, to-day astronomy has no other real use. We know that clocks are corrected through the observations of the stars, and that the sun and stars must be observed by navigators, but preparation for these practical applications forms a very trifling portion of the activities of astronomers. The very perfection of that part of astronomy reduces it to a sort of automatism—it all but goes by itself. To-day the astronomer wants to find out the dimensions of the sidereal system—the extent of the universe—the structure and arrangement of the stars in space—their relations to each other—the interpretation of their spectra—the dynamics of the universe—the cause of variable stars. The solutions of any or all of these questions can scarcely have any material effect upon mankind—the effect is spiritual and emotional—man is proud to find that he can plumb space to its uttermost depth; he presumes that the germ of the future which was conceived in the past is taking its form to-day, and that the process is continuous, and that as to-day he can predict tides and eclipses, so with greater knowledge he will in the future be able to predict the course of the sun amongst the stars and the future conditions of the planet upon which he has his being.

The Distances of the Stars.

The problem which will be more closely discussed in this address is that of the distance of the stars. The most direct way of finding these is by the parallactic displacement of the stars caused by the motion of the earth round the sun. In this inquiry the Union can have a local pride, as the first parallax[2] certainly found was that of α Centaurus by Henderson, the Cape Astronomer. The late Sir David Gill, our first president, continued Henderson's work, and perhaps one might say finished it in that form. Gill was an organiser, and when the parallax campaign, initiated by himself and completed with the aid of Dr. Elkin and others, had come to an end, it was apparent that the most direct[3] method of finding parallaxes which was available would only yield a small crop, because the stars are at such enormous distances from the sun that the available base-line for measurement, the diameter of the earth's orbit, some 186,000,000 miles, or 300,000,000 kilometres, is vanishingly small at the distance of all but a few near stars. α Centaurus is the nearest known, and almost certainly the nearest to the sun, yet at its distance the diameter of the earth's orbit subtends an angle of but 1½ seconds of arc—an angle which is described by the minute hand of a clock in a four-thousandth part of a second of time. An angle so small is difficult to observe directly with accuracy, so that at best the measures must become differential—that is, the stars are measured from neighbouring stars supposed to be at a much greater distance away; such stars are called comparison stars.

Prof. Eddington estimates that there are thirty stars with a parallax of 0·20″ or greater, of which nineteen are already known. This means that within a distance nearly four times as great as that of α Centaurus there are but thirty stars in all. This is the limit of visual work such as was done by Gill, but photographic methods, especially with the enormous telescopes used in America, carry the direct attack further.

The delicacy, or, if you prefer, the accuracy, of any measurement is limited by its probable error. The probable error of a parallax measured visually under good circumstances (such as with the Cape heliometer) is about 0·10″ (a tenth of a second of arc), and this is already, small as it is, a quantity larger than the quantity to be measured except in the cases of a hundred or so stars. The same method of parallactic displacement of stars on photographic plates has a much smaller probable error. The most recent determinations made with the great telescopes of America, and in particular the 40-in. refractor of the Yerkes Observatory, have a probable error of about 0·01″, or ten times less than the usual visual method, and Dr. Van Maanen, using photographs taken with the 60-in. reflector of the Mount Wilson Observatory, has reduced this probable error to 0·006″, or about a hundred and seventieth part of a second of arc. As regards the measurements of small quantities, this is a wonderful achievement, but delicate as these measure-

[2] But not the first announced. Bessel in 1838 announced the measurement of the parallax of 61 Cygnus two months earlier than Henderson, whose delay was caused by his removal to Europe.

[3] The only direct parallax found was that of α Centaurus, by Henderson. All other parallaxes of any certainty depend on an indirect method involving the assumption, nearly true, that all the stars with a few exceptions have very minute parallaxes.

ments are, they are too coarse to tell us much about the distances of the stars.

Let us consider several recent sets of parallax measures :—

(1) Van Maanen's list of five stars is as follows :—

Star	Parallax	Probable error
	"	"
96 ...	0·026 ...	+0·007
672 ...	−0·009 ...	0·004
1549 ...	0·001 ...	0·002
2921 ...	0·078 ...	0·006
3233 ...	0·003 ...	0·010

(2) In two recent lists we find parallaxes for 61 Cygnus, the star for which Bessel first found a parallax.

Authority	Parallax	Probable error
	"	"
Miller, 24-in. telescope, Sproul Observatory	0·301	+0·010
Slocum and Mitchell, 40-in. telescope, Yerkes Observatory ...	0·272	0·005

The negative parallax in Van Maanen's list would mean that the star was actually more distant than its comparison stars, which is at least unlikely, and in two other cases it will be seen that the parallaxes found are smaller than their probable errors. Somewhat similarly, in the case of 61 Cygnus, although the two parallaxes found agree very well, they differ by much more than their probable errors.

(3) In the recent most considerable list of stellar parallaxes published (Slocum and Mitchell, *Popular Astronomy*, March, 1914), out of twenty-eight results, eight are negative parallaxes and another four are smaller than their probable errors; yet the list is one of stars selected for large proper motion or some other peculiarity which indicated a measurable parallax.

These three sets show us that, valuable as the photographic method is, it is to be feared that it will also soon work out its rich lodes. So it does not take us much further. In this way the direct attack by parallactic displacement will reveal perhaps some one or two hundred parallaxes; but we would learn nothing as to the distances of the great mass of stars, except what we already know, namely, that the distances are tremendous.

Fortunately there is an indirect method of attack which, in the course of time, will tell us the distances of all the stars.

Basically this method depends upon a knowledge of the proper motions of the stars. If by its annual motion around the sun, the earth causes the stars to be displaced, it is obvious that the progressive motion of the sun through space must cause a progressive displacement. If for the moment we assume the stars to be at rest, they will seem to suffer two displacements—one purely periodic in a year, the other progressive, due respectively to the earth's orbital motion and the sun's motion through space.

The earth's orbital motion being periodic has no cumulative effect, but the sun's progressive motion is cumulative. The amplitude of the earth's periodic motion is about 300,000,000 kilometres, and all the best and most recent results show that the sun is moving through space with a velocity of about 18 kilometres a second; hence in a year the sun, and with it, of course, the earth and the rest of the solar system, move over a distance of 550,000,000 kilometres; roughly this is already twice the earth's annual displacement, and, as already stated, it is cumulative; thus, in six years, the progressive displacement is already eleven times the earth's periodical displacement, and the gain is continuous. Hence the mere lapse of time will tell us the distance of the stars, but the problem is complicated because the proper motions of the stars are not mere reflexes of the sun's proper motion; the stars themselves are also in motion, so that a process of unravelling is necessary. Without any unravelling, but by simple averaging, the elder Herschel found that the sun was travelling in the direction of the constellation Hercules. At Capetown, in 1905, Prof. Kapteyn announced his discovery that the proper motions of the stars divided themselves into two distinct drifts. The elder Boss found that the proper motions of a widely-spread group of stars converged to a point. The same astronomer also found, from a study of the proper motions, that there was a marked relation between the amount of proper motion and a star's spectrum.

Investigations based upon proper motions—the thwart or across the line of sight motions—were powerfully aided by spectroscopic results, and especially by the application of the Doppler principle, which tells us almost directly the radial velocity of the star, or its motion in the line of sight. The interpretation of stellar spectra is far from complete, and its problems will not be discussed to-night. The broad facts are that stellar spectra, with a few exceptions, fall into four great classes, which may be called the helium stars, the hydrogen stars, the metallic stars, and the carbon stars, in which the gradation from one class to another is so well marked that it is very plausibly assumed that a star of one class can in the course of time change into its contiguous class, and from that into its next class. At present it is assumed that the helium class is degrading or cooling into the hydrogen class, and that the hydrogen class is similarly approaching the metallic class (in which our sun is), and that later the metallic class will degrade into the carbon class, and that, finally, the carbon class will cool down and become dark stars. This continuous degradation is a convenient *memoria technica*, but it is not based upon any facts. Sir Norman Lockyer, by a closer study of spectra, asserts that there is both a descending and an ascending scale. The assumption that there are the dark stars above referred to is unsupported by any fact. But to-night we are only concerned with spectrum analysis as an aid to interpreting the proper motions of the stars. Radial velocities fully confirm the motion of the sun through space as disclosed by the proper motions. The recent spectroscopic determinations of the direction and amount of the solar motion made by Dr. Campbell in America and by Messrs. Hough and Halm at the Cape, agree within a reasonable margin with the determinations of Newcomb and Boss, which are based on proper motions. Further, as with the proper motions, it is found that as the stars degrade from helium to hydrogen to metallic to carbon spectra, their velocities increase. Prof. E. C. Pickering and others have shown how certain species of stars aggregate in certain parts of the sky. Thus the helium stars are only found near the Milky Way, that great girdle of stars which is the framework of the sidereal system. The direct measurement of parallaxes, and the smallness of their proper motions, both indicate that the helium stars are enormously distant; and conversely, that stars near us are generally of the metallic spectrum class. Besides the Taurus group of converging stars found by Boss, several other groups, with members spread all over the sky, have been found. The stars in these groups appear to be moving with nearly equal and parallel velocities through space. It is evident that once a star is grouped correctly, and the parallax or distance and velocity of any one star in its group is known, we can also determine its distance. Unfortunately the Doppler principle, by which astronomers determine the radial velocities of the stars, is somewhat limited in its application. In the helium and hydrogen classes the lines of the spectrum are

few and are difficult to measure, and in all classes it is only possible to measure the displacements of the lines of the bright stars. Even if we anticipate improvements in the art of spectrography, it would seem impossible to obtain spectroscopic data in the form required for more than twenty or thirty thousand of the brighter stars. Therefore, although spectroscopy will be a useful ally, its help is limited.

Let us now collect the data which are at the astronomer's disposal for finding the distance of the more distant stars. The most important datum is the star's proper motion. This is compounded of the reflex of the sun's motion and of the star's own proper motion, which latter may be eliminated by a process of judgment by assuming that the star is an average member of its group and spectral class, or that it belongs to one or other of Kapteyn's two drifts. Although in individual cases these indications may be very erroneous, yet in the gross they are permitting astronomers to classify the stars into manageable groups.

What is wanted is a better knowledge of the proper motions of the stars. Unfortunately at present these are not well known except for perhaps 10,000 of the brighter stars. Hitherto, the finding of the proper motions of the stars has been slow, arduous, and expensive work. At least ten meridian observations, spread over half a century, were essential, and each meridian observation cost about 20*s*., and meridian observations can only be made of the brighter stars—of perhaps 100,000 out of 1,000,000,000 stars now within the reach of the largest telescopes, or of one star in every 10,000. This proportion is altogether too one-sided. Hence astronomers hailed the advent of the photographic dry plate. An organisation for a *Carte du Ciel* was formed, in which our first president, the late Sir David Gill, was one of the chief promoters, and this scheme has now been at work for twenty-eight years; but, so far, the first *Carte* is far from complete. When completed in ten or twenty years' time, we may expect it to furnish us with precise positions of some 3,000,000 stars (or of about 1 star in 300, still a very small proportion). We will not know the proper motions of these stars. To achieve that, another *Carte du Ciel* must be prepared, so that we must expect another half-century to elapse before we are in possession of these 3,000,000 proper motions. Again, the labour, and with it the cost, involved is enormous, and will probably be in the neighbourhood of 10*s*. a star.

The drawback to these two methods of obtaining proper motions is the necessity for defining the exact position of each star at different epochs, whilst what we want is not its exact position, which is difficult to define, but its change of position—that is, its proper motion. At the beginning of this century it had been suggested that there was no necessity to measure the places of all the stars on photographic plates, but that if pairs of plates were examined in the stereoscope, those stars which had moved relatively would stand out in relief; alternatively, that if pairs of plates were superimposed, those stars which had moved by proper motion would easily be picked out. These suggestions were tried, and led to the discovery of a few proper motions, but the method was not workable on a large scale, mainly because of fatigue or strain upon the eyes. A third alternative was discovered by Dr. Pulfrich, of Jena, and described by him as a blink method. By this method the pair of plates to be examined is placed side by side, like the pictures in a stereoscope, but they are examined with one eye through an optical and mechanical arrangement which rapidly lets the eye rest first on one plate and then on the other, so that in one second the eye has looked at each plate separately three or four times. This blinking makes the eye wonderfully sensitive to the slightest shift upon the plates. If one star relatively to its neighbours has shifted a hundredth of a millimetre upon a *Carte du Ciel* plate, the change is not only unmistakable, it is obtrusive. This blink-method revolutionises astronomy of position as regards the stars. Both with the meridian observations and the *Carte du Ciel* measurements, each star had to be dealt with separately. In the blink method the stars are dealt with in groups. Indeed, one can say that it is easier to deal with 1000 stars by the blink method than with one by the other methods. All that the blink method requires is pairs of plates separated by as long intervals as possible. A few weeks ago Mr. Hough (H.M. Astronomer at the Cape) placed in Mr. Voute's and my hands a pair of plates with a time interval of nearly twenty-three years. There were about 10,000 stars on the two plates; in a few hours we were able to announce that only twenty of these showed proper motion—the rest were fixed stars—and we were able to find the proper motions of many stars which were so faint that even the great *Carte du Ciel* would not have included them. Since then further pairs of Cape plates have been placed at my disposal with intervals of sixteen to eighteen years; the results confirm the earlier experience. We can therefore clearly state that astronomers have now a weapon of attack which will in the course of time reveal to them, without arduous or expensive labour, the proper motions of all classes of stars from the brightest to the faintest. This will lead to a knowledge of the structure of the sidereal universe which a few years ago seemed unattainable. The immensity of the task when tackled by the old methods seemed so great, and the consequent delay so inevitable, that Kapteyn proposed that astronomers should concentrate their attention on certain selected areas which might be taken as representative samples of the whole sky.

A rude analogy will perhaps help us. The old way was something like studying the condition of England by means of a "Burke's Peerage" or a "Who's Who." Kapteyn proposed as better a limited number of selected areas, some urban, some rural; but the blink method will easily cover the whole area and permit an exact census to be taken.

The present state of astronomical science is one of great activity, but I have only time to make some brief references. The activities of the Union Observatory, an institution originally started by our association, call for some mention. The late Mr. Franklin-Adams planned a photographic chart of the whole sky, and more than half of the plates were taken at the Union Observatory. These were forwarded to the Astronomer Royal at Greenwich, and are undergoing examination. Some of the first results of this examination have been published in the Memoirs of the Royal Astronomical Society. Counts of the stars on these plates have been made by Messrs. Chapman and Melotte,[4] from whom the following figures are taken :—

Galactic Latitude	Plates taken in S. Africa	Plates taken in England
0° to 15°	988,000	515,000
16 to 30	616,000	383,000
31 to 50	406,000	230,000
51 to 90	307,000	145,000

This little table invites two comments—one is that the purity of the atmosphere has resulted in many more stars (nearly twice as many) being found on the plates taken at the Union Observatory; the other that the richness of the plates decreases more or less uniformly as the galactic plane—the Milky Way—is left. Chapman and Melotte also give this table, show-

[4] Mem. R.A.S., x.

ing the total number of stars in the sky, arranged according to magnitudes :—

Magnitude	Number	Magnitude	Number
2·0	38	10·0	272,000
3·0	111	11·0	698,000
4·0	300	12·0	1,660,000
5·0	950	13·0	3,680,000
6·0	3,150	14·0	7,650,000
7·0	9,810	15·0	15,500,000
8·0	32,360	16·0	29,500,000
9·0	97,400	17·0	54,900,000

So actually, the Franklin-Adams plates locate for reference at any time about 100 million stars, and these may be said to be all the stars known to astronomers. Special plates taken with the largest telescopes indicate a much larger number of stars—perhaps ten to fifteen hundred million in all. It will be noticed that the ratio from one magnitude to another, which is larger than 3 at the beginning of the table, progressively decreases, and is already less than 2 for the 15–16 magnitude; hence the authors conclude "that modern photographic telescopes penetrate to a distance at which the stars begin to thin out fairly quickly either really or by absorption."

Variation of Latitude.

Since March, 1910, and until December, 1914, the Union Observatory has, aided for some years by a subsidy from the International Geodetic Bureau, taken part in a scheme of observations for measuring the variation of latitude. I must be brief, and will only say that the question at issue was: "Is this variation common to the whole globe, or is it in part or wholly due to the elasticity of the earth, so that the deformation in the northern hemisphere might be different from that of the southern hemisphere?" The result of our observations to March, 1913, proves that in the variation of latitude the earth moves as a solid. In Dr. Albrecht's own words :—

"From this series of observations we can deduce an interesting confirmation of the result, previously obtained, that the values of the quantities x, y, and z deduced from observations made in the northern hemisphere, can be applied without any modification to the variation of the latitude in the southern hemisphere." [5]

Gravitation.

For upwards of half a century it has been known that the law of gravitation seems to be insufficient to account for all the planetary motions—the most conspicuous exception being the motion of the perihelion of Mercury's orbit—and it has been found more recently that it is impossible to reconcile the moon's motion with gravitation. Recently Sir J. Larmor and Mr. H. Glauert have proved that a certain amount of these irregularities are due to variations in the length of the day; Glauert finding that the length of the day has increased by a hundredth of a second in a third of a century. This means that as compared with a third of a century ago, the year will appear to be about 3½ seconds longer. Such a change, because of our methods of determining time, will be most clearly reflected in the motion of the first satellite of Jupiter, the eclipses of which can be observed with an accuracy of about one second, and the motion of which is the most purely periodic that is known. Since 1908, every visible eclipse of this satellite has been observed at the Union Observatory, so that in the course of time we may expect that our observations may assist in the solution of an obscure problem.

In dealing with the structure of the sidereal universe, or in a smaller way with the dynamics of a star-cluster, it is often tacitly assumed that gravitation is the only force at work. That gravitation is not universally applicable we see in the solar system in the phenomena of comets' tails, and even more so in the disintegration and disappearance of periodic comets such as those of Biela and Holmes. Many double stars are undoubtedly subject to the law of gravitation in all its purity, but in far many more gravitation appears to be at most only a secondary (thus in the case of double stars of which both components are of the helium type, there do not appear to be any signs of gravitative action between the two stars). It is true that stars with variable radial velocities have been found spectroscopically, and their orbits deduced by purely gravitational principles, but in many of these cases it is not indubitably certain that the shift in the lines of the spectrum is due to recession or approach. The difficulty is that in the so-called earlier type of stars, it is found that the H and K lines of calcium do not share in the variable motion on which the binary orbit is based. The interpretation of spectra—the contradictory behaviour of different lines, their thickness and intensities—still provides problems to be solved. In this connection one must refer to the illuminating papers by Dr. Nicholson on the relation between atomic structure and the lines in the spectrum. Nicholson's work makes much use of the spectra of nebulæ, in which we see matter under simpler conditions than is possible on earth. At this meeting Prof. Malherbe is reading a paper upon "Atoms, Old and New," which will go further into this subject than is possible here.

Organisation of Astronomy.

In the earlier part of this address I dwelt upon the power of organisation under scientific direction. I am tempted to develop the subject, limiting my example of organisation to the science of astronomy, which is truly international in its aims. Astronomers are scattered all over the world, and pursue their work independently of the people amongst whom they live, and who provide the money necessary for their existence. The people are not ungenerous, but they cannot be critical. The astronomer is on his honour as it were, and this is nearly good enough, but not quite. If the astronomer is a man of sufficient initiative and energy with a regulated imagination, he will not require much supervision, but he may feel that without the co-operation of his colleagues spread over the world his work may be one-sided. He sees the need for organisation, and such organisation is not quite unknown, and has been found beneficial. Such occasional events as the transits of Venus and total eclipses of the sun generally lead to some loose co-operation. More organised affairs were the Star Catalogue of the *Astronomische Gesellschaft* (a society having its headquarters in Germany, but with international aims). It divided the sky into zones, and allotted these to certain observatories, which were willing to co-operate. The catalogues actually published have been contributed by Austria, England, Holland, Germany, Norway, Sweden, Russia, and the United States. This organised effort, started in 1868, is still going on. The other and more important organisation is that of the *Carte du Ciel*, started in 1887, and in which our first president took a leading part—he was connected with it from its inception, and when he died he was the president of the Commission. The scheme for the variation of latitude observations is also an international organisation.

All these organisations were voluntary. In every way they were useful. The problem is whether we can extend the organisation to the whole body of astronomers, and yet not destroy their initiative. A control, however light, which would destroy initiative would be fatal. At present many observatories furnish an annual report. Thus the Royal Astronomical

[5] Rapport sur les Travaux du Bureau Central en 1914, p. 6.

Society in London publishes reports from most of the observatories in the Empire; the *Astronomische Gesellschaft* does the same for all the German, many Continental, and a few American observatories; the French Government publishes the annual reports of all French observatories. Other observatories furnish annual reports to their own Governments or controlling bodies, and some of these are printed and circulated. Still other observatories, and these in no small number, publish no reports. The change I advocate is a very small one; it is that every observatory should furnish an annual report to its authority, and that these authorities should transmit the reports to an international association of astronomers, for comment and return. The report should be divided into sections somewhat as follows:—(1) Working staff of observing astronomers, non-observing astronomers, comprising computors and ordinary assistants; (2) detailed list of instruments which cost more than 250*l.* apiece; (3) how many observers have permanent quarters in the grounds? how many non-observers have ditto?; (4) efficiency of those instruments in past years in percentage of hours available for work; (5) observations secured in past year; (6) observations published, being prepared for publication, etc.; (7) unpublished observations made in previous years—reason for non-publication; (8) projected lines of work; (9) general notes and explanations.

All these reports should be examined and analysed by a committee of the international association and then published. The committee would then make its suggestions to the controlling bodies, leaving these to act on them or not. In this way the careful minister or even the conscientious member of Parliament could find out the opinions which an expert body holds concerning the institution for which he is asked to vote money. The advisory body could suggest to those astronomers who have sufficient equipment, but make no use of it, useful lines of research. The ardent astronomer who cannot persuade his Government to provide funds would find himself in a stronger position when he has behind him an international body. The lethargic astronomer would find that his colleagues elsewhere look to him to do his share. Better than all, it might be possible to arrange that research students could visit and work at observatories the equipment of which is not in full use. It would be invidious to give examples of observatories not working up to their potentialities—few can—but several make no attempt at any work, and have become little better than sinecures[6]—it must suffice to say that at least two of the observatories possessing exceptionally large refracting telescopes have not contributed one month's work from them in the last twenty years—their expensive equipment is idle and slowly deteriorating—the output from many others is disappointingly small. If some international association had the power to recommend that these great telescopes were put into commission, or, better still, to assign research students to their use, it would be a good thing.

In ancient days princes and men of wealth founded religious institutions called abbeys and monasteries. They did so because they considered they were helping the cause of humanity—and for centuries these bodies did respond to a real need—but the need passed, and only effete institutions remained—ultimately to be swept away—and to-day princes and men of wealth do not found abbeys. In modern times—the most ancient observatory is not old—princes and men of wealth found observatories because they consider they are helping the cause of humanity. It is unnecessary to push the analogy. The ardent astronomer will not permit it to be pushed too far; he will organise with his colleagues for the advancement of his science, and the consequent enlargement of man's intellectual horizon.

I have only dealt with the organisation of a branch of science somewhat widely detached from the current activities of the world. It would have been too ambitious to sketch the organisation of a State or of humanity at large. But such organisation must come. The war every day is showing us how necessary it is to organise for production—even if only in the munitions of war—and not for profit. We are living in dangerous times, times in which it behoves the man of science, who is actuated by no selfish interests, to exert his power in remoulding the new society when the time, now near at hand, comes.

The notable discussion in the House of Commons on May 13 last (reprinted in NATURE of May 20) on the motion of the Government to form an Advisory Council on Industrial Research, sets an example, which is sure to be followed by other British communities. All the debaters spoke of the extraordinary example of Germany rising to great material power through the spread of technical education and scientific research. No country can afford, or would be justified, in lagging behind, but a more ethical objective should be the ideal.

In South Africa several problems have suggested themselves, but the experimental work would be very costly, and might, after all, be insufficient, so that their solutions do not appeal to private enterprise. The local production of liquid fuel is one of these problems. Liquid fuel can be made both from low-grade coals and from agricultural produce, and it is within the range of probability that what to-day are considered noxious weeds, such as the prickly pear, might have an economic value in the production of alcohol. Again, the extraordinarily favourable duration of sunshine in the Union invites the trial of sun-power boilers, especially for pumping. A census of the water power "white coal" is also desirable, because if we have no great falls of water excepting the Victoria Falls, we must remember that our high veld rivers have a descent of 6000 ft. to sea-level, some of which is probably economically available.

If science is co-ordinated knowledge, what is the man of science? The true type is a man of faith, believing in the power of co-ordinated knowledge to make the world a purer and a better one. If the object of science was only the material conquest of nature it would be unworthy, and sooner or later it would be rejected by mankind. The faith of the man of science is unlimited—he might declare his creed in words somewhat as follows[7]:—

"I believe in the ultimate distinction between Good and Evil, and in a real Process in a real Time. I believe that it is my duty to increase Good and to diminish Evil. I believe in doing so I am serving the purpose of the World. This I know and I do not know anything else; I will not put questions to which I have no answer, and to which I believe no one has an answer. Organic Action is my creed, Abstract speculation weakens Action. I do not wish to speculate; I wish to act; I wish to live."

Or, he says, using the words of Bacon:—

"The knowledge of Truth, which is the Presence of it; and the Beleefe of Truth, which the Enioying of it; is the Soveraigne Good of Humane Nature. The first Creature of God, in the workes of the Dayes, was the Light of the Sense; The last, was the Light of Reason; And His Sabbath Worke, ever since, is the Illumination of His Spirit."

[6] They may provide a time or meteorological service of some local importance, but as institutions for research work of any kind their efforts are negligibly small. At least 33 per cent. of the observatories listed in the Nautical Almanac publish nothing.

[7] Adapted from "Appearances," by G. Lowes Dickinson (1914).

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING.

THE ninth annual report of the president and the treasurer of the Carnegie Foundation for the Advancement of Teaching, for the year ending September 30, 1914, shows a total endowment of 2,850,000*l.*, a surplus of 249,000*l.*, an annual income of 149,200*l.*, and an annual expenditure of 143,200*l.* Of this 6400*l.* was spent in administration, 9400*l.* in educational inquiry, and 126,800*l.* in retiring allowances and pensions. During the year twenty-nine retiring allowances and fifteen widows' pensions were granted, the average grant being 329*l.* 10*s.* The total number of allowances now in force is 332, the total number of widows' pensions 100, the general average grant being 319*l.* The total number of allowances granted since the beginning of the foundation is 595, the total expenditure for this purpose being 710,200*l.*

A comprehensive study of engineering education has been undertaken at the request of a joint committee representing the six national engineering societies. In co-operation with these societies a study of the history of important engineering schools and land-grant colleges has been made. Numerous engineering schools have been visited, special studies are being made of the situation of the student upon entering and upon leaving his engineering studies, and several thousand engineers are co-operating in formulating the views of the profession concerning the present methods and results of the engineering schools.

Because engineering is relatively a new profession, its professional consciousness is not as well developed as that in medicine and law, as is evidenced by the fact that engineering societies are of comparatively recent date. Thus the American Society of Civil Engineers, organised in 1852, held its first convention in 1869. The similar organisations of the mechanical and the electrical engineers were formed in 1880 and 1884 respectively.

Because of this newness of the demand for engineers, the engineering schools of the United States have had to do much pioneer work in education. Founded, as most of them were, since 1860, in response to the needs of growing industries for men trained in applied science, they have had to blaze their own trail through the forests of educational tradition; and, particularly in the early years of their existence, have had to defend their practices against existing habits of educational procedure. This fact makes the study of engineering education one of particular interest and importance, since it inevitably led to modifications in school practices both in the engineering colleges themselves and in the colleges for liberal humanistic training.

Although engineering was much simpler when the colleges were established than it is now, the founders of these institutions recognised clearly the novelty of the demands they were trying to meet, and organised their schools with a definite purpose of meeting those demands as fully as possible. The curricula of the early schools were devised only after a careful study of the conditions which the young engineer would have to meet on emerging from his course. That these curricula and the methods of training used were well adapted to the purposes for which they were devised is shown by the admirable results obtained. The wonderful development of the country in industrial and technical lines is in no small measure the work of the graduates of the engineering colleges, and stands as a monument to the far-sightedness, the sound instincts, and the high ideals of the men who guided the work.

But this rapid expansion in industrial and technical lines, aided at every turn by the equally rapid development of science, has resulted in making the field of engineering very broad and extremely complicated. Engineers have been forced to specialise in limited fields, and each year has witnessed a higher degree of specialisation and an increase in the amount of subject-matter which must be included in the curricula of the schools. To meet this situation, the engineering schools have gradually patched the original curriculum by adding new subjects here and there and subdividing their instruction into an ever-increasing number of more highly specialised courses. The demands on the student's time have become severe, and the ingenuity of faculties to frame time-schedules which shall satisfy the requirements of all the various departments is being taxed to the utmost.

That there is a pressing need for a full and thorough study of engineering education is clearly recognised by the engineering profession. This recognition has manifested itself in the organisation, in 1893, of the Society for the Promotion of Engineering Education, and in the increasing attention which the engineering societies and the engineering Press have given to this subject. It has recently been clearly expressed by the appointment of a joint committee on engineering education, whose membership is made up of fifteen representatives of the leading national engineering societies, and whose function is "to examine into all branches of engineering and to formulate a report on the appropriate scope of engineering education."

The Carnegie Foundation is undertaking this study of engineering education in close conference and hearty co-operation with this committee. An important part of this inquiry will consist in a study of the conditions into which a young engineer enters immediately on graduation, and of the estimates which the engineering profession has formed of his needs and his equipment. Another part of the inquiry will consist of a study of the aims, the purposes, the curricula, the methods of teaching, and the educational experiments and investigations of the engineering schools. Such material, arranged in compact form, should be of value to schools and teachers, no less than to engineers and students.

The steps being taken to found an American Association of University Professors are of interest to all workers in higher education.

The movement has been inaugurated by a meeting held in Baltimore for the formation of a national association of university professors. For some years university teachers have realised that specialisation in teaching tended more and more to bring them together as specialists, not as unversity teachers. The physiologists, chemists, and philologists meet in groups, but nowhere has there been provided a body under which all university teachers shall come together, not as specialists but as university teachers, to consider the problems and the organisation of higher education. Such a body ought to be able to promote in a helpful way the discussion of questions relating to higher education and to the organisation and conduct of our universities; such, for example, as the organisation of universities into departments, the relations of research to teaching, the awarding of degrees, the methods of appointment and promotion, the relations of faculties and trustees, and numerous other questions directly affecting the ideals and the needs of university teachers and affecting no less the progress and development of the universities themselves.

Such a body bringing together university teachers in all subjects, who meet not as specialists but as men engaged in teaching, ought to exercise an admirable influence in arousing in the minds of a large number of university teachers now absorbed in their own specialities an interest in university questions and a greater readiness to study such questions together. Too many university teachers are content to be ab-

sorbed in their own fields of study or research, and give little time or thought to the larger problems of university life and university progress. Such a body as this ought to furnish the opportunity and the incentive towards such thinking.

Such an organisation of university teachers ought to accomplish much in the creation of what one might call professional consciousness. It will help towards a more definite appreciation on the part of teachers themselves, and on the part of the public, of what it means to be a university teacher. The association may well hope in time to grow into an influence comparable in the case of university teachers to that exercised by the American Bar Association for lawyers or by the American Medical Association for physicians. Hitherto there has been little of professional solidarity amongst university teachers. The term professor has had with us a very indefinite meaning. It has been applied unthinkingly to secondary-school teachers, college teachers, university teachers, and to many whose connection with teaching is most remote. In this uncertainty lie certain difficulties which the association will meet, for in the public mind there is as yet no very clear differentiation between the university professor and the secondary-school teacher, just as many of our universities are such in name only.

The plans of the Association of University Professors have not yet been worked out to the point of detailed organisation. Doubtless those who have the matter in charge have in mind a somewhat loose organisation like that of the lawyers rather than a highly detailed organisation like that of the physicians. So far as the plan has as yet developed, it contemplates nothing further than the formation of a body representative of university teachers, a body in which questions affecting the work of the university and the interests of teachers, the relations of schools and colleges, and similar questions, may be discussed from the point of view of university teachers, and which may present to university bodies and to the public a statement of such questions from the point of view of the profession itself. Those who have to do with universities and colleges, whether as trustees, presidents, or teachers, will welcome this movement heartily.

The foundation's earlier studies of medical education are continued in this report in recommendations for changes in the classification of medical schools; a study of medicine and politics in Ohio; and a survey of medical education on the Pacific coast, which shows that the State of Washington, which has no medical school, has a plentiful supply of physicians trained in good schools all over the country, while California, with eight medical schools, is swamped with poorly trained doctors.

The report concludes with a discussion of "Standards and Standardisers," which shows that the Carnegie Foundation has had little to do with the setting up or enforcement of college standards, this being the work of college faculties. All that the foundation has done is to cause fuller discussion of such matters and to urge the claims of honesty and sincerity.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A BURSARY in memory of Mr. Robert Hepburn has been founded by his sister at University College, Dundee. It will be tenable for three years, and open to any male or female student of medicine at the college.

PROF. W. MORGAN, who fills the chair of automobile engineering in the faculty of engineering of the University of Bristol, has been released from his duties for the period of the war. He will, we understand, be engaged upon work in connection with the production of munitions.

THE governors of Guy's Hospital have received from the trustees and executors of the will of the late Sir William Dunn 25,000*l.* new War Loan 4½ per cent. fully-paid stock for the endowment of a lectureship in pathology in the Guy's Hospital Medical School, to be known as the "Sir William Dunn Lectureship in Pathology."

IN connection with the erection of the permanent buildings of the University of Western Australia, two prizes of a hundred guineas and twenty-five guineas respectively were offered for the two best designs for the laying out of the University's grounds at Crawley Park, Perth, W.A. A large number of designs were sent in, and the following awards have now been made by the board of adjudication:—First prize, H Desbrowe-Annear, Melbourne, Victoria; second prize, H. W. Hargrave, Perth, W.A. The design submitted by Messrs. J. Cheal and Sons, Ltd., Crawley, Sussex, has in addition been granted an honourable mention.

WE are requested to make known that the latest date for the receipt of applications from candidates desiring to be examined at Local Centres for the Aitchison Memorial Scholarship is September 1, and from those who wish to be examined in London, September 15. Applications should be made to Mr. H. F. Purser, 35 Charles Street, Hatton Garden, E.C. It will be remembered that the scholarship in question was founded in memory of the late Mr. James Aitchison, in consideration of the many and valuable services rendered by him to the optical industry and the development of optical education, and specially in recognition of his unselfish and constant endeavour to secure better training for optical students. The scholarship course, tenable at the Northampton Polytechnic Institute, Clerkenweil, covers two years, and its total value is 30*l.* It is proposed to offer the scholarship in alternate years.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 17.—M. Ed. Perrier in the chair.—Paul **Appell**: Contribution to the study of the Θ functions of higher degrees.—W. **Kilian** and Antonin **Lanquine**: The coexistence, in the neighbourhood of Castellane, of pyreneo-provençal dislocations and of Alpine folds, and on the complexity of these orogenic phenomena.—Joseph **Pérès**: Bessel's functions with several variables.—H. G. **Block**: The equation of elastic rods.—José Rodriguez **Mourelo**: The phototropy of inorganic systems. The case of calcium sulphide. These sulphides were made by heating precipitated chalk (100 gr.), common salt (0·1 gr.), sodium carbonate (0·03 gr.), sulphur, and certain phosphorcgens, such as manganese and bismuth salts. The colour develops in a strong light, not sunlight, in two or three minutes. In one set of experiments the proportion of manganese added varied between 0·1 per cent. and 0·0001 per cent. The observed colours passed through reddish-violet, pink, to an intense violet, the maximum phototropic effect being obtained with 0·005 per cent. of manganese. The colours were increased in intensity by the addition of both manganese and bismuth.—M. **Pontio**: A method of control for rapidly estimating the quantity of nickel deposited in nickel plating. The method is based on the use of a solution of dilute hydrochloric acid and hydrogen peroxide, which attacks the underlying metal (copper, iron) more rapidly than the deposited nickel.—Alberto **Betim**: A layer of euxenite in Brazil. This deposit

was found near Pomba (Minas-Geraes), Brazil. A spectrographic analysis of the mineral showed the presence of titanium, niobium, yttrium, ytterbium, erbium. Chemical analysis proved uranium (4 to 11 per cent. of the oxide), thorium, traces of cerium, tin, arsenic, lead, gallium, and gold.—Ed. **Delorme**: A new mode of grafting the flexor tendons of the fingers. In cases of severe wounds of the palms of the hands, with loss of one or more of the flexor tendons, an operation has been devised, full details of which are given, in which portions of the flexor tendon of the fore-arm are grafted over on to the hand.—E. **Kayser**: Contribution to the study of the ferments of rum. It is shown that the use of the microscope can render great services in rum manufacture: it can prove contamination, and direct the fermentation to obtain products of constant composition.—Em. **Bourquelot** and A. **Aubry**: The influence of soda on the synthetic and hydrolytic properties of α-glucosidase (glucosidase from low yeast, air dried). A set of ten experiments, in which the proportion of caustic soda was gradually increased, gave results showing that the synthetic reaction was not sensibly affected so long as the mixture remained acid. In a neutral mixture the reaction does not attain its normal equilibrium, and with distinct alkaline reaction the synthetic reaction stops, although no secondary isomerising reactions have been set up by the alkali.

New South Wales.

Linnean Society, June 30.—Mr. A. G. Hamilton, president, in the chair.—A. R. **McCulloch**: Notes on, and descriptions of, Australian fishes.—H. S. H. **Wardlaw**: The temperature of *Echidna aculeata*. The temperature of Echidna shows a regular daily variation of about 3° C., its morning temperature being about 30° C., and its afternoon temperature about 33° C. These temperatures are considerably lower than the temperatures of most other mammals (37° C.). During winter in Sydney, Echidna hibernates for short periods at a time. During the periods of hibernation, its temperature sinks almost to the level of the air, so that Echidna behaves like a cold-blooded animal.—R. J. **Tillyard**: The development of the wing-venation in zygopterous dragon-flies, with special reference to the Calopterygidæ. The paper deals with the tracheation of the larval wing in the genera Calopteryx (Palæarctic) and Diphlebia (Australian), the only two genera of the Calopterygidæ available for study. The results are most important, since they establish the fact that, throughout the suborder Zygoptera, the radius is unbranched, whereas in the Anisoptera it always possesses a branch, known as the *radial sector*, which crosses over the two most distal branches of the media. In the Anisoptera, the media has only three branches besides the main stem. In the Zygoptera it has *four*. The extra branch lies between M_2 and M_3, and is *analogous* to, but not *homologous* with, the radial sector. For this newly demonstrated branch the name *zygopterid sector* is proposed, with the notation Ms, to preserve the analogy with the radial sector Rs. Important results following from this are (1) that the crossing of Rs over M_{1-2} no longer separates the Odonata from all other insects; (2) that the dichotomy between Anisoptera and Zygoptera becomes far more pronounced than heretofore, by the basic difference in the condition of the radius in the two suborders; (3) that Handlirsch's fossil suborder, Anisozygoptera, must be dropped; all these fossils, tested by the character of the radius, become true Zygoptera.—Dr. S. J. **Johnston**: *Moreauia mirabilis*, gen. et sp.nov., a remarkable trematode parasitic in Ornithorhynchus. This worm lives in the anterior part of the intestine of the platypus, in the spaces between the transverse folds of the mucous membrane, where it lies completely hidden. It is remarkable in its lateral expansion, being five times as broad as it is long. It is so different in its structure from known forms that it is looked upon by the writer as the representative of a new subfamily with fairly close affinities to Liolopinæ.

BOOKS RECEIVED.

The Yearbook of the Universities of the Empire, 1915. Pp. xii+717. (London: H. Jenkins, Ltd.) 7*s.* 6*d.* net.

The National University of Ireland. Calendar for the year 1915. Pp. clxxxiv+583. (Dublin.)

Thèses présentées à la faculté des Sciences de l'Université de Paris. Série A. No. 764. Pp. 155. (Marseille: Barlatier.)

Outlines of Sociology. By Prof. F. W. Blackmar and Dr. J. L. Gillin. Pp. viii+586. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 8*s.* 6*d.* net.

Elementary Algebra. By F. Cajori and L. R. Odell. Pp. vi+206. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 3*s.* net.

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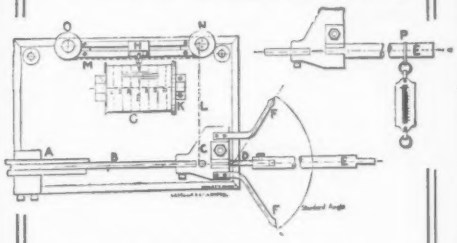

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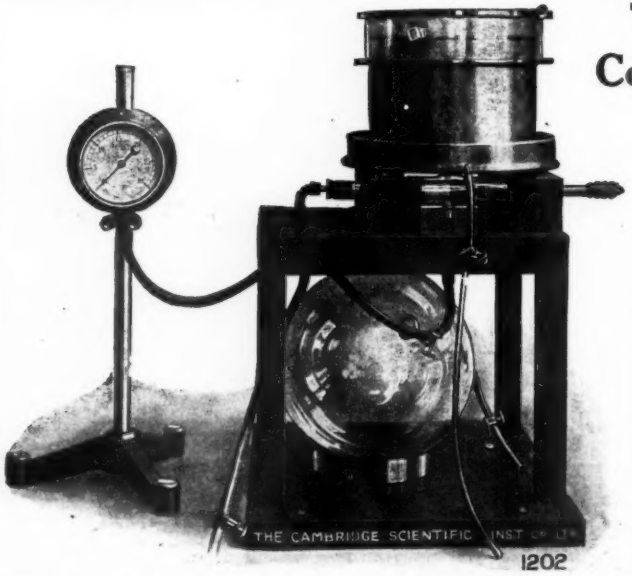

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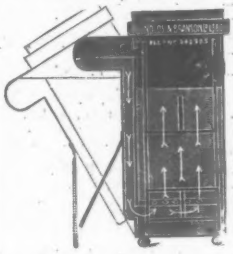

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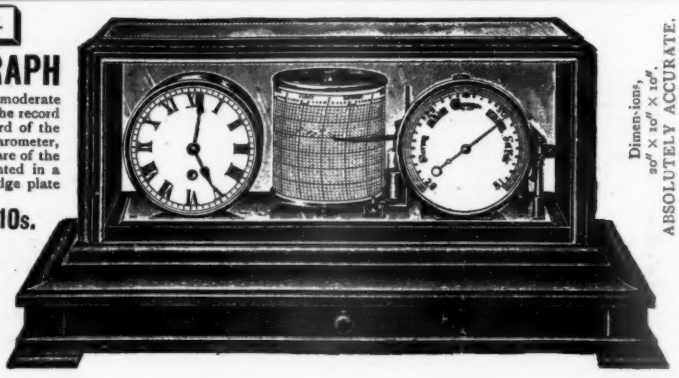

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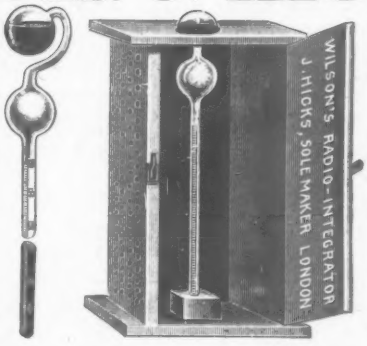

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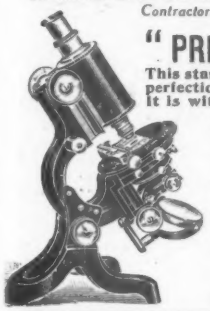

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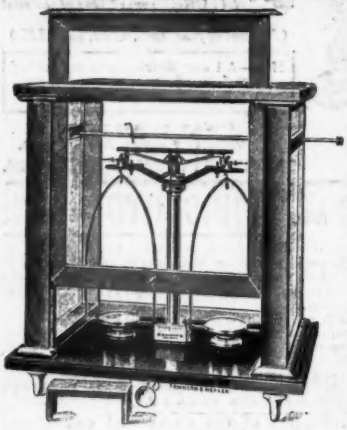

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